Vol. 12 No. 4

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The PROGRESSIVE FISH-CULTURIST

Vol. 12 No. 4

OCTOBER 1950

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

THE PROGRESSIVE FISH-CULTURIST

Issued by
UNITED STATES DEPARTMENT OF THE INTERIOR - - - - - OSCAR L. CHAPMAN, SECRETARY
FISH AND WILDLIFE SERVICE - - - - - - - - - - - - ALBERT M. DAY, DIRECTOR

The printing of this publication has been approved by the Director of the Bureau of the Budget, August 31, 1949.

Vol. 12, No. 4 October 1950

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(See inside back cover)

The PROGRESSIVE FISH-CULTURIST

News and Views from many Sources on Practical Hatchery Problems

Volume 12 | Washington, D. C. | October 1950 | Number 4

TABLE OF CONTENTS

	Page
Construction and Use of Small Trap Nets --by W. R. Crowe	185
Present Status of Fishery Management in Oklahoma --by Bill Thompson	193
Fish-Planting Tank for 3/4-Ton Pickup Truck --by Earl Leitritz	197
Survey of Systems Used in Measuring Lengths and Weights of Fishes, and of Systems Proposed as Standard, in the Southwest --by F. T. Knapp	207
Fish Growth Rates Read Directly from the Projected Scale --by Leonard Joeris	209
Distribution Units for Warm-Water Fish --by A. J. Wilson	211
The Chipman Meat Cutter --by J. R. Chipman	215
Quickly Changed Dip Net --by F. J. Richan	217
Publications	
Reprint:	
Salmon (*Salmo salar* L.) with No Adipose Fin --by Gunnar Svardson	221
Green Bay Walleyes --by Ralph Hile	223
Review:	
Fortschrittliche Karpfenteichwirtschaft --by Wilhelm Wunder	225
Measuring Well Water --by H. R. McDonald	227
Clearing House	228

Items

Urethane Anesthetization 195
Extra-Boned Sea Trout 196
Research on the Sea Lamprey 216
Motor Directional Switch 220

Index 229

(Photo and drawings courtesy the author)

CONSTRUCTION AND USE OF SMALL TRAP NETS

Walter R. Crowe
Michigan Department of Conservation
Ann Arbor, Michigan

FISHERY workers, particularly those concerned with inland lakes, are constantly faced with the need for more adequate collecting gear. Ideally, one type of net could be used to secure samples of all sizes and kinds of fish from all habitats. The worker needs only a minimum of netting experience to realize, however, that such efficient gear is probably nonexistent. The present paper describes the construction and use of a type of small trap net which has proved a very useful supplement to the gear used by the Michigan Institute for Fisheries Research.

Some years ago the Institute employed a commercial fisherman who, with his own equipment, was to make population studies in various inland lakes of the State. It was at once evident that his gear, though heavy and cumbersome, was highly efficient and that commercial nets, primarily designed for use in the Great Lakes, could be used advantageously in smaller waters. The major difficulties encountered in using such gear were those associated with the sheer manual labor involved in handling the nets. Also, because of their bulk, the operation of the nets was very difficult until the operator had acquired some proficiency in their use. Transporting the nets from one lake to another and getting them laid out ashore for drying was a major undertaking. Once the nets were set, however, they could be operated with ease. Nets of this type could be considered practical only when an extensive netting program was being conducted

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A contribution from the Michigan Institute for Fisheries Research.

on a single body of water and when it was desirable to catch fish in large numbers. These nets required the use of a heavy boat, and a large truck was needed to move them from one lake to another. Later in the program, another commercial fisherman was employed. His equipment was considerably lighter and more portable than that of his predecessor, and certain construction details made his nets easier to handle. The major differences were that his nets were constructed with a single pot or crib and the back bridle was fastened to all four corners of the unit, thereby dispensing with a spreader (the notched stick used at the back of the net to keep the top and bottom brails separated when the net is in the water). His nets apparently took fish as well as those first used. The problem of bulk and weight remained, but to a lesser degree. It was felt that if the size of the nets could be reduced sufficiently to permit the use of smaller floats and leads and lighter webbing and rope, the total weight might be reduced to the point where lighter anchors could be used, thus greatly reducing the weight and bulk of the entire gear. This saving in weight and bulk would, of course, result in much improved portability and ease of handling. The descriptions and figures given here deal with nets incorporating these modifications.

Figure 1 depicts the essential features of the trap nets now being used by the Institute. The basic design is that of the submarine trap net used extensively in the Great Lakes region. The type with the double pot has been illustrated. Fish striking the leader follow it into the entrance and gradually work their way to the back of the net. When the gear is lifted, only the back end is raised, and fish are removed from the pot through lace holes in the top. The few fish remaining in other parts of the net may be removed or allowed to remain and work their way to the back of the net.

Trap nets have displayed many advantages in population study work. These nets are generally less selective than gill nets at any particular depth or habitat, capturing readily most species of warm-water fish. As the fish are impounded, unwanted specimens may be released unharmed and removed much more rapidly than from gill nets. Trap nets will capture both largemouth and smallmouth black bass in midsummer, a function gill nets assuredly will not perform consistently. The trap nets have the further mechanical advantage of not being easily torn, snagged, or entangled. They may be dried in any reasonably clear area ashore and they are relatively durable because of their seine-twine construction. For the capture of cold-water species, such as trout, whitefish, and herring, they have not been very reliable except under special circumstances; on occasion, however, they have performed well even for trout.

The first small trap net was made and used in 1947. It had a pot 2 feet deep, 2 feet wide, and 6 feet long, and a 200-foot leader 2 feet in depth. This net performed reasonably well as compared with the experimental gill nets used previously but was disappointing in comparison with the larger traps. It was light and very easily handled, however, and its use for a season showed how later models might be improved. Incorporation of desirable modifications has now resulted in a unit which is considered quite satisfactory. These modifications entailed altering dimensions of the leader to 100 feet by 4 feet and adding a small umbrella of netting to extend across the opening between the wings where the 4-foot leader tapers to join the 2-foot mouth of the net. The Institute has had five additional trap nets constructed. These nets are 3 and 4 feet deep and have 100-foot leaders. Total weight of each unit, with anchors and anchor lines, is approximately 100 pounds. This weight can be distributed in two or three packages, for the leader and the trap usually will be handled separately when the nets are moved or laid out to dry.

The nets do have certain physical limitations. Generally, they cannot be operated efficiently in water deeper than 35 feet. A firm bottom with a gradual slope facilitates their use, for the nets should be taut, and in a soft bottom the anchors will not hold. This difficulty can usually be solved by the operator's ingenuity. For example, it has been found

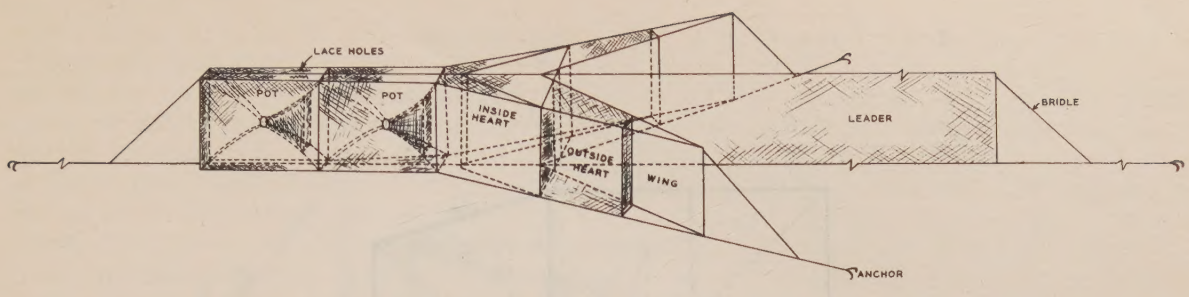


Figure 1.--Diagrammatic view of trap net in position.

that the net can often be held firmly in such bottom by tying a 6-inch board between the points of the anchors or by lengthening the anchor lines.

Figure 2 is a working drawing that shows construction details. Dimensions can be adjusted to meet specific applications; but if the nets are to be moved frequently and bulk and weight are to be kept low, the net illustrated is close to the maximum size which might be termed a "small trap." Certain construction details which are not illustrated need to be mentioned. The twine in the pot is 12-thread seine twine; that in the remainder of the net is 9-thread seine twine. The heavier twine in the pot is desirable because it is subjected to the greatest amount of wear by being pulled over the gunwale of the boat. The float line is 6-thread Manila, and the lead line is 9-thread Manila. We have used aluminum gill-net floats, 4-1/2 by 1-1/2 inches, throughout the unit. For weights, we have used 5-ounce split gill-net leads, which can be pinched directly on to the lead line. The head anchor line should be not less than 100 feet long, and a longer line is generally preferable, especially when operating in deeper water. Lines to the side anchors have usually been 50 or 75 feet long. The ends of all bridles are fastened around a thimble which permits ropes to travel freely and acts as a pulley. See figure 3.

The nets should be treated with preservative. Even though there are other materials which are pleasanter to use and handle, the Institute has found tar-treated nets very satisfactory, and commercial fishermen generally consider the black color desirable.

When nets of this type are being used, certain items of equipment are essential or desirable. The following suggestions are made, as the items listed have been found satisfactory, but any operator will soon learn which items he finds needful.

Boat.--Nets of this size may be set from almost any rowboat, but a thoroughly reliable work boat is a blessing. The ordinary resort rowboat is frequently unstable. Because the operator needs to stand when handling and setting the nets, the boat should be large enough to allow the operators free movement and to permit net storage without undue crowding. Though the various types of car-top boats will serve, they cannot be recommended as a work boat if many nets of this type are to be handled. Good results have been obtained from a boat 15 feet 6 inches long with a 24-inch freeboard and a 56-inch beam. The gunwales should be free of obstructions so that the operator may pull nets and lines over the side or stern without fear of snags. Also, the gunwales should be of hardwood, for lines to which tension has been applied will quickly wear away softer woods. A gunwale stringer, inboard from the ribs, strengthens the boat and provides a convenient place for tying lines temporarily. The single seat should be set well forward, leaving the after part of the boat clear as a work space. A refinement which has proved worthwhile is to construct the boat with a square bow as well as a square stern, so that the operators may use an outboard motor attached to either end of the boat.

Gear.--Extra Manila line should be carried to replace broken anchor ropes or to lengthen anchor lines in case the anchors slip. A coil of 100 feet or so of 84-thread maitre cord equipped with

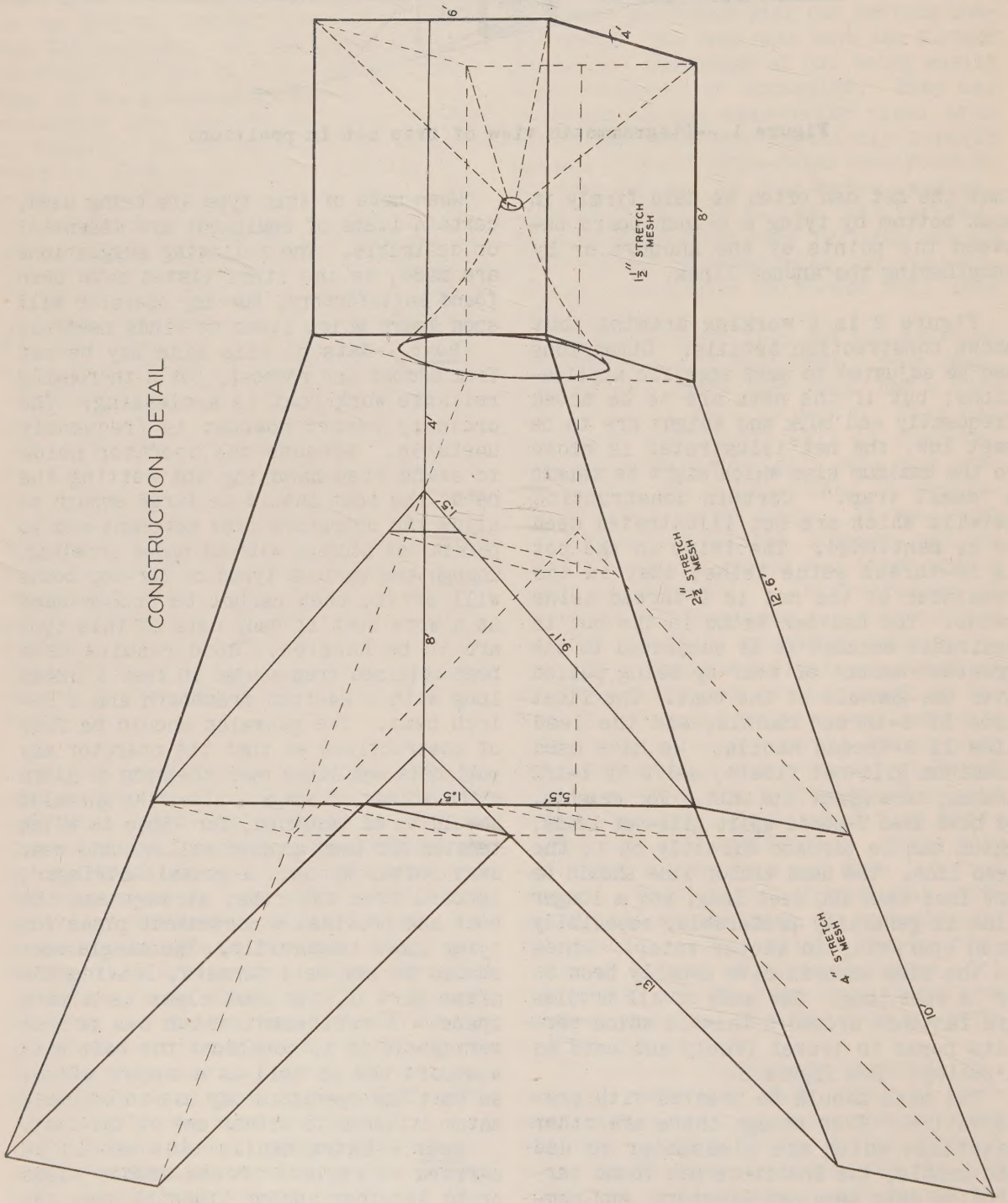


Figure 2.--Scale drawing of small trap net. Mesh sizes also given.

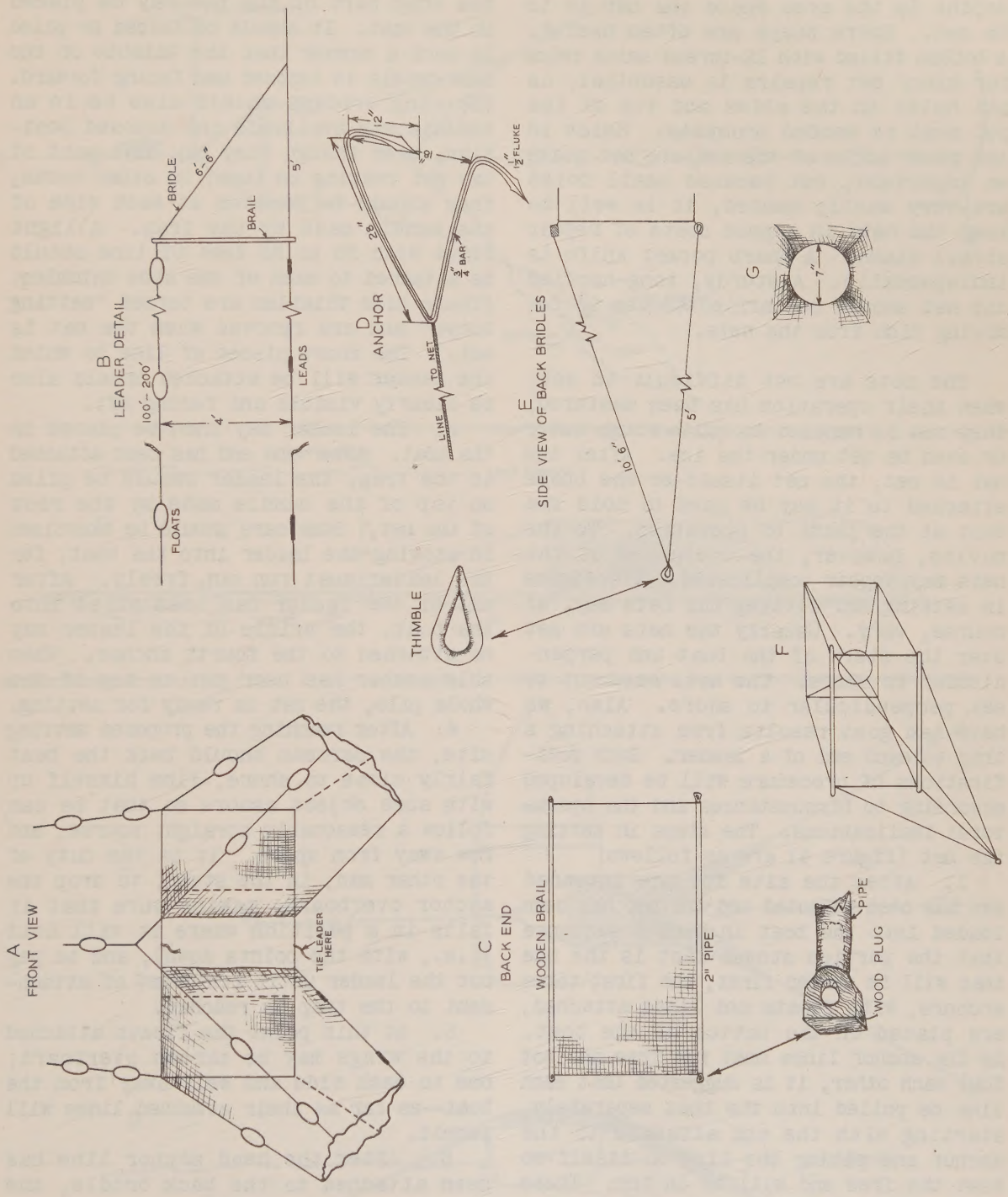


Figure 3.--Perspective views of small trap net. a. Front view showing entrance to trap and point of attachment for leader. b. Detail of leader showing bridle to shore anchor. c. Back end of trap showing brail and pipe construction. d. Detail of anchor. e. Detail of bridle to head anchor line. f. Perspective of net viewed through back end, showing funnel and bridles. g. Funnel entrance.

a sounding lead is also very useful. It may be used to ascertain the approximate depths in the area where the net is to be set. Extra buoys are often useful. A bobbin filled with 12-thread seine twine for minor net repairs is essential, as all holes in the sides and top of the pot must be mended promptly. Holes in the other parts of the net are not quite so important, but because small holes are very easily mended, it is well to keep the nets in a good state of repair at all times. A sharp pocket knife is indispensable. A sturdy, long-handled dip net should be carried to use in removing fish from the nets.

The nets are not difficult to set; when their operation has been mastered, they can be handled in quite rough water or even be set under the ice. After the net is set, the net itself or the buoys attached to it may be used to hold the boat at the point of operation. To the novice, however, the operation of the nets may appear complicated. Procedures in setting and lifting the nets may, of course, vary. Usually the nets are set over the stern of the boat and perpendicular to shore. The nets need not be set perpendicular to shore. Also, we have had good results from attaching a trap to each end of a leader. Such modifications of procedure will be developed according to circumstances and the operators' inclinations. The steps in setting the net (figure 4) are as follows:

1. After the site for the intended set has been selected and the net has been loaded into the boat in such a sequence that the portion stowed last is the one that will be needed first, the first three anchors, with floats and lines attached, are placed on the bottom of the boat. As the anchor lines must run free and not foul each other, it is suggested that each line be pulled into the boat separately, starting with the end attached to the anchor and piling the line on itself so that the free end will be on top. These ends are then tied to the gunwale stringer for convenience in locating them promptly. The head anchor, with line attached, should be placed in the middle of the boat; the side anchors should be placed on each side, somewhat forward of the head anchor.

2. When the anchors are in place, the trap part of the net may be placed in the boat. It should be folded or piled in such a manner that the thimble on the back bridle is exposed and facing forward. The wing bridles should also be in an immediately available and exposed position, even though they may have part of the net resting on them; in other words, they should be exposed at each side of the bundle made by the trap. A light float with 20 to 30 feet of line should be attached to each of the side thimbles. (These side thimbles are termed "setting buoys" and are removed when the net is set.) The short pieces of line to which the leader will be attached should also be clearly visible and facing aft.

3. The leader may then be placed in the boat. After one end has been attached to the trap, the leader should be piled on top of the bundle made by the rest of the net. Some care should be exercised in stowing the leader into the boat, for the leader must run out freely. After all of the leader has been piled into the boat, the bridle of the leader may be attached to the fourth anchor. When this anchor has been put on top of the whole pile, the net is ready for setting.

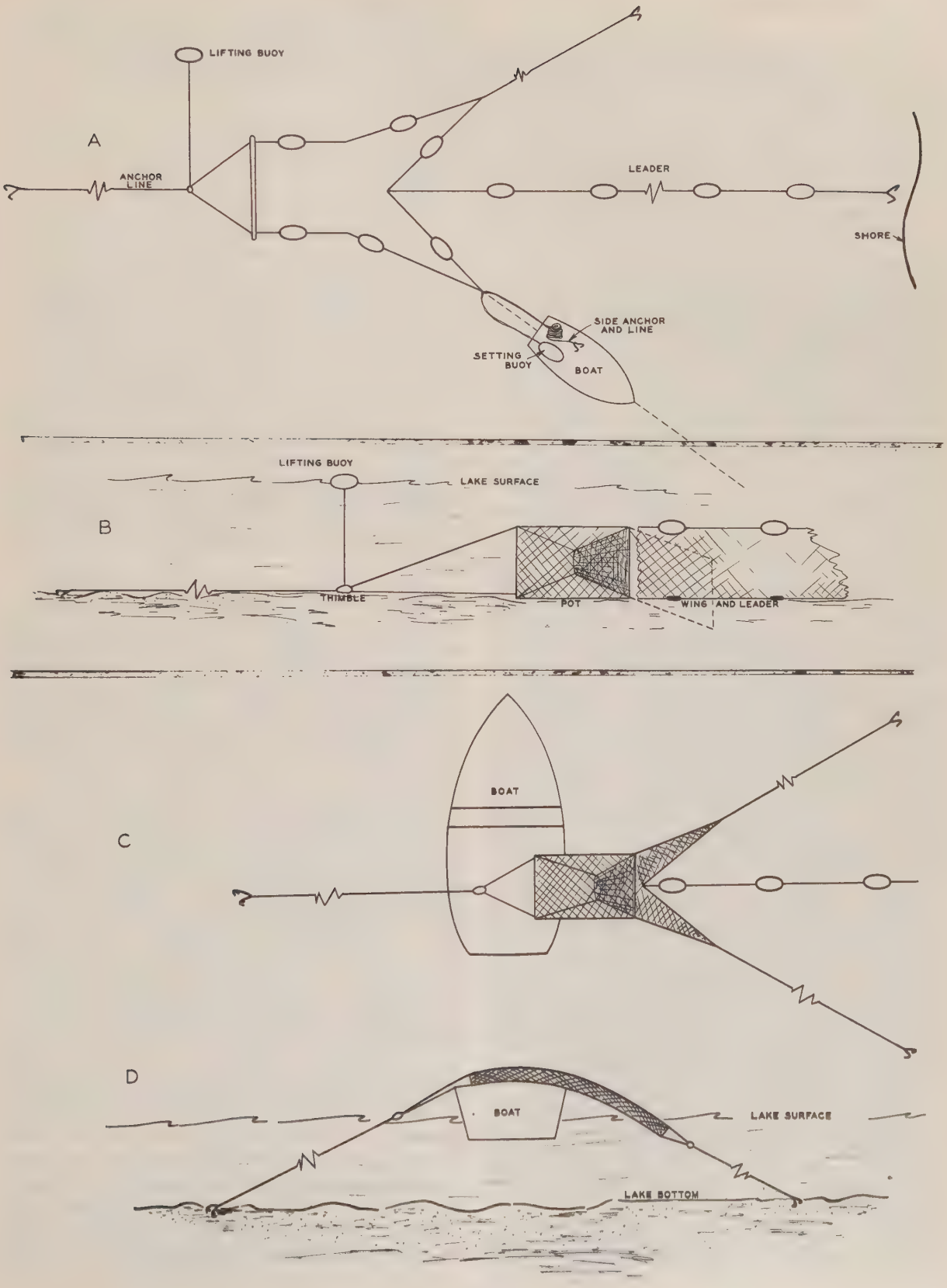
4. After reaching the proposed netting site, the oarsman should back the boat fairly close to shore, line himself up with some object ashore so that he can follow a reasonably straight course, and row away from shore. It is the duty of the other man, in the stern, to drop the anchor overboard, making sure that it falls in a position where it will hold (i.e., with the points down), and to pay out the leader until its point of attachment to the trap is reached.

5. At this point the floats attached to the wings may be thrown overboard, one to each side and well away from the boat--as far as their attached lines will permit.

6. After the head anchor line has been attached to the back bridle, the

(Opposite page)

Figure 4.--Diagrammatic illustration of method used in setting and lifting net. a. Setting the wings. b. Net in position on bottom of lake. c. and d. Net lifted and resting across boat.


A
LIFTING BUOY
ANCHOR LINE
LEADER
SHORE
SIDE ANCHOR AND LINE
SETTING BUOY
BOAT
B
LIFTING BUOY
LAKE SURFACE
THIMBLE
POT
WING AND LEADER
C
BOAT
D
BOAT
LAKE SURFACE
LAKE BOTTOM

rest of the trap may be pushed off the stern.

7. The oarsman again pulls away from the net, and the man in the stern pays out the anchor line until the anchor is reached. The boat should now be approximately in line with the anchor which was dropped nearest the shore. Now the head anchor should be dropped overboard.

8. Next, the net should be partially tightened by the following procedure: The operators should return to the lifting buoy, pull up the bridle, and untie the anchor line from the thimble--but let it run through the thimble. The free end, having passed through the thimble (which acts as a pulley), is grasped while the line leading from the anchor to the thimble is pinched against the gunwale of the boat. Now, by pulling on the line, the operators may take up slack in the net and anchor line. The photograph illustrates the tightening process. When most of the slack has been taken from the net, the free end of the line is secured to the anchor line by a midshipman's hitch and the boat is pushed from under the bridle. The net should not be tightened finally until the wings have been set.

9. The spreading of the wings is perhaps the most difficult part of the procedure. The oarsman must approach one of the setting buoys (preferably the upwind one) in such a position that the man in the stern can grasp the buoy while the boat is headed on the course (shown by the dotted line, figure 4-a). When the thimble in the side bridle has been secured, one of the side anchor lines should be attached. The wing should make an angle of approximately 45° with the line of the leader. The boat may then proceed along the course while the man in the stern pays out the anchor line. When the end of the line is reached, the anchor is dropped overboard and the process is repeated with the other wing.

10. The operators should return to one or the other of the wing buoys and tighten the wings sufficiently to remove slack. The method used in tightening the wings is the same as that already described for the lead anchor.

11. After the wings have been somewhat tightened, it is necessary to return to the lifting buoy and tighten the net again. If the anchors are holding properly, the net may now be pulled taut. Generally, it is best to pull the nets as tight as possible, for a tight net fishes better than a loose one. Also, it is obvious that in deep water the net will slacken somewhat when dropped back into the water.

12. Lifting the net to remove the fish is a simple procedure. It will usually pay to approach the lifting buoy with the boat headed into the wind. The boat is shoved under the pot girdle (figure 4-b, 4-c, 4-d). The net is pulled over the side far enough to permit the operators to brail the fish through the lace holes with a dip net. When the pot is full of fish, they may be held in the water at the side of the boat. To reset the net, it is necessary merely to lace up the lace-holes and slide the boat from under the net. It is seldom necessary to loosen the net to remove fish or to reset the net.

13. Taking the net from the water in order to change its location or to dry it, is a relatively simple procedure. After being untied from their respective bridles, the head and two side anchors are brought into the boat. Then the operators return to the lifting buoy and haul the net into the boat, starting with the trap and finishing with the leader.

Concerning the cost of the net, no very accurate figures can be given. Labor will run about 55 percent of the cost, and materials about 45 percent. Any of the regular net and twine manufacturers could deliver the net complete, or a competent commercial fisherman could build it. Anchors can be made locally. Roughly, the net illustrated can be built for about $200. Larger nets may be built somewhat more economically, for the labor involved on a larger net is not much greater than for a small unit. The nets, if kept in a reasonably good state of repair, are very durable and can be used for 8 to 10 years. They should be dipped in preservative at least every other year and should always be patched as the need arises. Also, when in use, they should be washed and dried periodically.

PRESENT STATUS OF FISHERY MANAGEMENT IN OKLAHOMA

Bill Thompson
Oklahoma Game and Fish Department
Norman, Oklahoma

OKLAHOMA now has approximately 300,000 surface acres of water, exclusive of streams. Most of these waters consist of artificial impoundments. Only 8 or 10 natural lakes are in existence in the bottoms adjacent to some of the main streams. Though these cut-off lakes have created fine angling in some instances, they are not considered of major importance to the angler because of their small numbers. The waters of primary interest to the sportsmen of Oklahoma are the artificial impoundments.

In 1900, only two artificial lakes encompassing 10 surface acres or more were in existence in Oklahoma. By 1920, 38 lakes had been completed; by 1924, 79 were in existence; by 1940, the State had 171. By 1946, Oklahoma had 188 artificial lakes and these covered 187,722 surface acres of water. In addition, at this same time the State had completed 71,000 farm ponds covering 60,000 surface acres. (Oklahoma Planning and Resources Board.) Between 1946 and 1950, additional private, industrial, municipal, and federal water-construction programs increased the area of artificial impoundments to an estimated 300,000 surface acres. The dam-building programs of the U. S. Corps of Engineers and the Bureau of Reclamation promise a substantial increase beyond the present water area during the next few years.

The almost sudden development of the large water resources in Oklahoma has created responsibilities in fishery management without precedent. Strange and entirely new problems relative to the fishery resources of artificial lakes have been thrown into the laps of biologists and administrators. In addition to these problems of a technical nature, we are confronted with a tremendous task of re-education.

Unfortunately, as in most States, the original fish-management practices in Oklahoma were not all directed toward better angling. For many years heavy emphasis was placed upon stocking, closed spawning seasons, and size and bag limits. These policies suggested the belief that natural reproduction was not adequate to keep pace with fishing pressure. No one seems to be aware of the real basis for such conclusions. Perhaps we were listening to some of the other States. More than likely some of us remembered the certain little trout stream that had been stripped by fishermen in a few days, after which there were no more trout until artificial propagation supplied them. At any rate, Oklahoma fishermen accepted as one of their primary principles, "Conserve the fish." In line with general conservation teachings, this idea seemed sound. It was a noble gesture to sacrifice for the future, but in this case too little attention was given to the actual need. The old concepts of fish management did not properly evaluate the reproductive potentials of our waters and the effects of fishing pressure. In spite of the false premises, these early concepts were accepted zealously among the lawmakers and sportsmen. Today, game and fish administrators and biologists are confronted with the problem of selling the sportsmen a new but correct concept

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Mr. Thompson is Director of the Fisheries Experiment Station, set up by the Oklahoma Game and Fish Department in cooperation with the University of Oklahoma Biological Survey.

in preference to the old ideas.

Seven years ago Oklahoma began her about-face and long trek back to better fish management. Through the influence of one Oklahoma fishery administrator, it was decided to eliminate the closed spawning season on a trial basis. After two seasons general agreement put an end to all closed spawning seasons. The second step of importance to the State was the decision by the Oklahoma Game and Fish Department to invest in fishery research. On September 1, 1947, the Department set up the Fisheries Experiment Station in cooperation with the University of Oklahoma Biological Survey. Other research projects were established thereafter with the cooperation of the Corps of Engineers, Oklahoma A. and M. College, and the U. S. Fish and Wildlife Service.

The information derived from Oklahoma waters, coupled with information from other States, has now paved the way for the third step. Early in 1950, the Oklahoma Game and Fish Commission handed down the decision to remove white crappie from the protected list, the final decision to be subject to the outcome of a public hearing.

Upon what grounds does Oklahoma justify this complete reversal in fish-management procedures? The findings of our biologists are in perfect harmony with the statement of Michigan's F. A. Westerman: "The evidence leads to the conclusion that stocking is unnecessary, uneconomical, or even harmful if the species suited to the environment are already present." Actually, the much higher reproductive potential of our southern waters accentuates such a statement from a northern State. We can say without reservation that the greatest menace to good angling in Oklahoma is overpopulation.

Good fishing in new artificial reservoirs, as opposed to poor fishing during later years of the impoundments, has in the past been explained on the basis of rapid utilization of the available nutritive elements and selective overfishing. Neither is the answer to poor fishing in most older Oklahoma waters. The answer is too many fish. Our sports fishing pressure is inconsequential; our commercial fishing efforts are too meager. The older waters are now supporting 500 to 1,000 pounds of fish per surface acre, but the vast majority of these fish may be stunted beyond the fisherman's imagination. (See table 1.) The legal limit imposed on some game fishes eliminates a high percent of the population from the creel because their growth is so slow that they do not reach the legal size in abundance. Even temporary good fishing for game species is, in such instances, dependent upon the rare occasions when substantial numbers of one or several year classes reach a ripe old age. Overpopulation is especially serious in the south because of the shorter life span of fishes. A species that must live 4 to 6 years before attaining legal length is rarely of importance, numerically, to the fisherman. Overpopulation implies too many fish, but too many stunted fish means fewer keepers.

What can be done to improve fishing where the fish are reproducing themselves into overpopulation? First, we must realize that the philosophy of "save the fish" is folly and is leading us to ruin. We must refrain from pouring more hatchery fish into overpopulated waters. There is no such thing as corrective stocking in Oklahoma when populations have become stunted. The lack of space or living room becomes as critical in a large reservoir as in a small body of water; more hatchery fish reduce further the available space. Certainly we need no restrictive measures directed toward reducing the harvest of our fish crops. We must accept extensive commercial fishing programs as one of the possible saviors of sports fishing.

If these recommendations are followed, the chances of prolonging the peaks of good angling are enhanced. It is doubtful that all these measures will control southern fish populations. The possibility of control through commercial fishing shows more promise when used alone, perhaps, than either of the others. The difficulty of harvesting the annual crops of nonschooling fish will be a problem in some of our deeper lakes. It still remains to be seen whether commercial fishing will do the job. The last resort toward controlling fish population may be through the use of rotenone. Considerable experimental work has been done in

TABLE 1.--Comparison of growth of white crappie in two overpopulated lakes and in a recently drained and rejuvenated lake

(Numbers of fish used in averages are in parentheses.)

Body of water, Oklahoma, 1949	Average total length at end of year of life					
	1	2	3	4	5	6
Grand Lake	2.1 (8)	5.3 (164)	7.2 (39)	10.5 (20)	13.3 (1)	14.4 (2)
Claremore City	3.2 (25)	5.3 (194)	6.4 (30)	7.9 (2)	-	-
McAlester City*	9.9 (39)	12.2 (3)	-	-	-	-

* McAlester City Lake was drained in 1947. All fish were removed or killed with rotenone. The gates were then closed, and the reservoir was allowed to refill. New brood stock was planted during the fall of 1948. Forty-two fish were removed from the lake on October 20, 1949.

several States, as well as in Oklahoma, and the possibilities are encouraging. In many small lakes, spot killing will no doubt preserve our fishing; in large lakes, the operation may be so expensive that it can be offset only by virtue of the fact that we may be able to market the recovered fishes.

By some means we must harvest our fish crops if we are to preserve good fishing in our reservoirs.

URETHANE ANESTHETIZATION

Studying the effects of urethane anesthetization, fishery workers of the Oregon State Game Commission made, at separate points, four liberations composed of equal numbers of treated and untreated tagged fish. Examination of the recoveries showed that 57.4 percent were fish that had been anesthetized with urethane. The experiment indicated that the treatment was beneficial to fish that must be handled for tagging, and the time required for tagging was decreased by 31 percent.

The Commission also used urethane in connection with the removal of adipose and right pelvic fins from 5,000 fall rainbow trout. These fish, which averaged approximately 68 per pound, were anesthetized with 0.5 percent urethane prior to the clipping. The 4-percent mortality which occurred at clipping time was not believed to have been due to the urethane.

EXTRA-BONED SEA TROUT

Those who use bone counts to determine the species of fish are warned to make sure that what looks like a different species is not just a heat-induced variant. The work of Dr. A. Vedel Taning on sea trout at the Marine Biological Laboratory at Charlottenlund Slot, near Copenhagen, Denmark, indicates that sharp drops or rises in temperature cause trout eggs to develop into fish with extra backbone segments.

Having noted that there is a brief moment during development when the embryo is supersensitive to heat changes, Dr. Taning subjected eggs to increases or decreases of 50° F. and more. Eggs developing at medium temperatures were kept at near-freezing temperatures for about 8 days and then returned to the original temperature; eggs developing at near-freezing temperatures were put in a warm environment for about 24 hours. Both groups produced young fish having extra spinal vertebrae, although the cold-treated fish had more than the heat-treated fish. The average increase was 3.2 over the 57 vertebrae of the parent fish.

These changes are not inherited. Normally raised offspring have the usual number of bones.

For a number of years the California Division of Fish and Game has mailed postal cards to a random sample of the anglers who purchased licenses to fish in that State. On the basis of returns, California's fisheries administrators have estimated total catches, average catches, and numbers of anglers fishing for the important fresh-water and anadromous fishes in each calendar year. About a third of the recipients have responded with great regularity, and such returns have been large enough to show major trends. As there has always been much uncertainty as to whether the individuals who returned the questionnaires could be considered representative of the general angling population, this matter was given special attention in 1948. That year a special personal interview survey was made to determine the influence of postal card nonresponse upon the postal card survey estimates. In general, the individuals who returned the cards were found to be highly representative of the angling public as a whole; apparently the nonresponse caused no important warping of mean catches, total catches, numbers of anglers, or trout angler migrations.

FISH-PLANTING TANK FOR 3/4-TON PICKUP TRUCK

Earl Leitritz
California Division of Fish and Game
San Francisco, California

A SMALL fish-planting tank, adapted for use with a 3/4-ton pickup truck and assembled mostly from standard parts and materials, was designed by employees of the Bureau of Fish Conservation in 1948. At present, 21 of these planting tanks are in operation, distributing fingerling and catchable-sized trout from our hatcheries. Loads of 200 pounds of catchable trout averaging from 3 to 5 per pound are normally carried at temperatures ranging from 52° to 60° F. for 1½ to 5 hours, and varied loads of fingerlings running from 700 to 1,200 ounces and averaging from 12 to 23 per ounce are hauled. Except for a slight rise in temperature which occurs on long trips, these tanks are proving very satisfactory.

Specifications of this fish-planting tank are, in brief, as follows:

Capacity	150 gal.
Length of tank	42 in.
Width of tank	35 in.
Depth at center	28-3/4 in.
Width at frame	34-1/4 in.
Over-all length of frame	61-3/4 in.
Weight of empty tank complete with all components and ready to operate	430 lbs.
Weight of water and 150 lbs. of fish, tank filled to top	1,300 lbs.
Total weight of loaded and operating tank	1,730 lbs.
Weight of empty 3/4-ton Chevrolet Pickup	3,570 lbs.
Total weight of truck and loaded tank	5,300 lbs.

Complete aeration of the water is effected by pumping from the front of the tank, forcing the water through the aspirator and mixing chamber, and returning it through narrow-slotted fish-tail pipes at the rear of the tank. The pump is located on the right side of the tank in order to provide better load distribution and is mounted on synthetic rubber cushions. The suction side is connected to the tank by means of a short piece of 1½-inch automobile radiator hose. Connection to the discharge line is also made in this manner, which allows the motor mounts and hose connections to absorb most of the engine vibration. Water

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See also:

Copeland, T. H.
1947. Fish distribution units. Prog. Fish-Cult. 9 (4): 193-202.

Stoddard, J. V.
1948. Refrigerated live-trout distribution tank. Prog. Fish-Cult. 10 (2): 91-94.

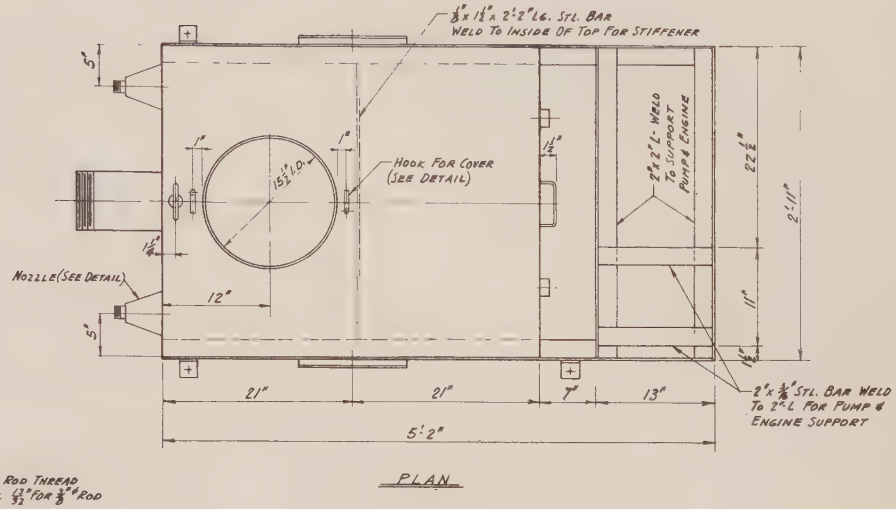
Stubblefield, A. G.; Lefevre, Lorin; and Smart, Rex
1949. Montana fish-distribution tank. Prog. Fish-Cult. 11 (4): 245-252.

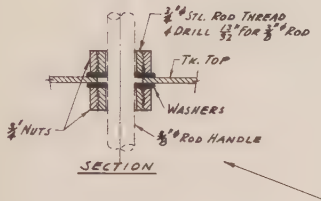
is taken near the bottom at the front of the tank and from behind a perforated plate extending the full width and one-half the height of the tank. This large perforated plate is intended to eliminate the possibility of having the suction side of the pump become obstructed. Water is discharged through the aspirator and mixing chamber, which are mounted in the line in a vertical position, and carried to the bottom of the tank; here the line is divided by means of a tee into two lines, one line running inside each frame member to the rear of the tank; thence the lines are brought up and the water is discharged into the tank near the bottom through two fish-tail pipes, each of which has an opening approximately 1/8 inch by 5 inches. In this manner water is taken at the front of the tank, forced through the aspirator, and returned at the rear. The aspirator really picks up considerably more air than the water can absorb, and this surplus air rises to the surface at the rear of the tank in the form of large bubbles. The amount of air taken in by the aspirator can be regulated to some extent by adjusting a small air cock at the aspirator intake. Further adjustment and regulation of the water flow may be made by adjusting a brass straightway cock which is located in the discharge line.

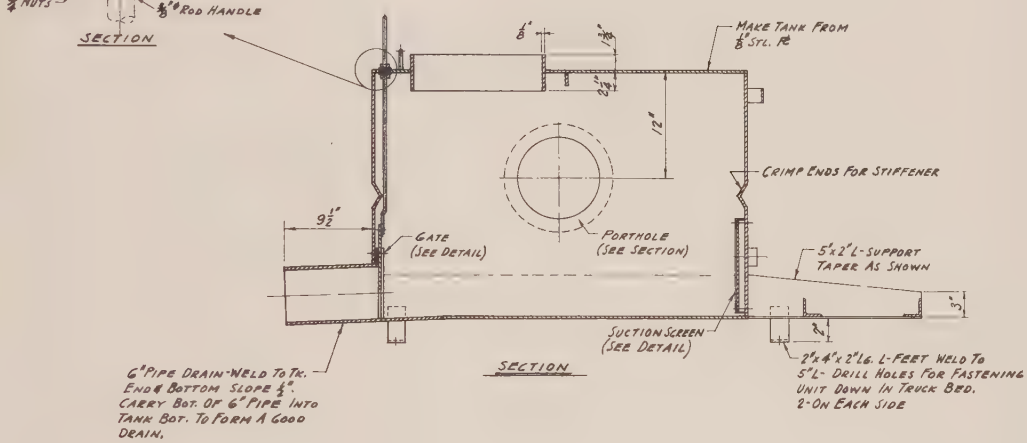
The tank is not insulated, and some rise in temperature will result if the tank is used on long trips during extremely warm weather. Although the loaded tank, weighing more than 1,700 pounds, makes nearly a recommended load for a 3/4-ton pickup, the tank is not large or bulky, and sufficient space remains in the pickup bed for carrying ice and other planting equipment such as nets and buckets. Our tank is painted inside and out with aluminum paint to improve its appearance and possibly aid in reflecting heat rays. When requisitioned from the manufacturer, the tank is specified as black iron, unpainted. This is done in order to eliminate the harmful gases which result when such pieces as the outlet and fish-tail pipes are welded into place. The "V" bottom allows for ease in draining, and the 6-inch outlet pipe is attached in such a way that the pipe is cut away and allowed to extend along the bottom of the tank. This causes the drain pipe to be slightly inclined but eliminates any ridge or obstruction at the outlet. A sliding gate, not watertight, operated from the manhole by a hand lever, prevents the fish from entering the outlet pipe and reduces water escapement while the pipe cap on the end of the outlet pipe is removed. Round inspection ports, 12 inches in diameter and covered with ½-inch clear plexiglass, are located on each side of the tank; these permit easy observation of the fish being carried.

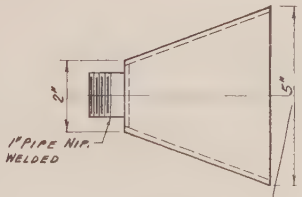
In the design of the tank, consideration has been given to durability, efficiency, and ease in operation, as well as to the possibility of further alteration and improvement. In the discharge line, immediately above the pump, a hose bib to which a 10-foot piece of 3/4-inch hose is connected enables the operator to pump out any water not desired after some of the fish have been removed, as well as to fill planting buckets. A small pressure gauge near the instrument panel of the truck is connected to the discharge line between the pump and aspirator by means of a length of ¼-inch copper tubing. This gauge indicates a few pounds of pressure at all times when the pump is operating satisfactorily. The perforated aluminum plate, fastened to an angle-iron frame which fits the contour of the lower half of the tank, is held in position by six wing nuts which force the screen frame tightly against the end of the tank; this allows for easy removal of the screen should removal become necessary. Sufficient space remains for the mounting of another pump on the left side; this second pump would be connected to the unit in the same manner and would be operated in case of failure of the right-hand pump. Connection of the suction line to the tank is made by sawing in two a 1½-inch pipe coupling and welding one of these pieces to the tank, then removing the small piece of tank material surrounded by the coupling. The fish-tail discharge pipes are made of any suitable material by means of a welding torch and are securely welded to the rear of the tank at the proper location. Entrance for

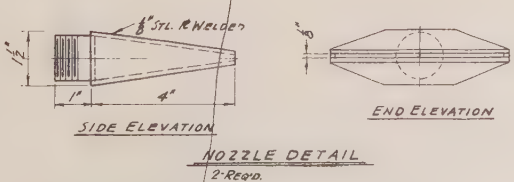
(Drawings courtesy the author)

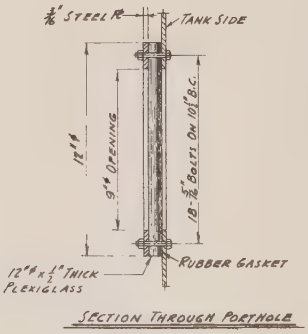

⅜" x 1½" x 2'-2" Lg. Stl. Bar Weld To Inside Of Top For Stiffener
Hook For Cover (See Detail)
2"x2"L- Weld To Support Pump & Engine
Nozzle (See Detail)
2"x⅜" Stl. Bar Weld To 2"L For Pump & Engine Support
21"
21"
7"
13"
5'-2"
PLAN

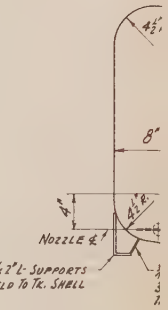

⅜" Stl. Rod Thread & Drill 13/32" For ⅜" Rod
Tk. Top
Washers
¾" Nuts
⅜" Rod Handle
SECTION

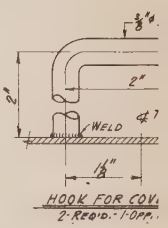

Make Tank From ¼" Stl. Pl.
Crimp Ends For Stiffener
Gate (See Detail)
Porthole (See Section)
5"x2"L-Support Taper As Shown
Suction Screen (See Detail)
6" Pipe Drain-Weld To Tk. End & Bottom Slope ¼". Carry Bot. Of 6" Pipe Into Tank Bot. To Form A Good Drain.
2"x4"x2"Lg. L-Feet Weld To 5"L- Drill Holes For Fastening Unit Down In Truck Bed. 2-On Each Side
SECTION

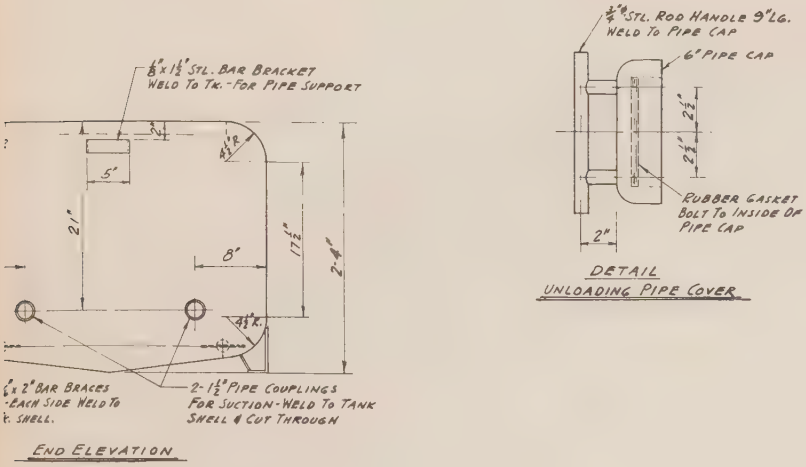

1" Pipe Nip. Welded
PLAN

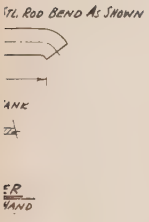

⅜" Stl. Pl. Welded
SIDE ELEVATION
END ELEVATION
NOZZLE DETAIL
2-Req'd.

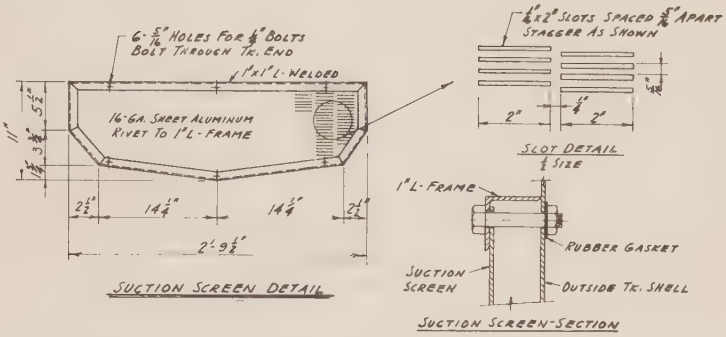

⅜" Steel Pl.
Tank Side
9" Opening
18-⅜" Bolts On 10½" B.C.
Rubber Gasket
12"x½" Thick Plexiglass
SECTION THROUGH PORTHOLE

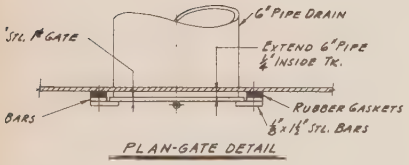

Nozzle

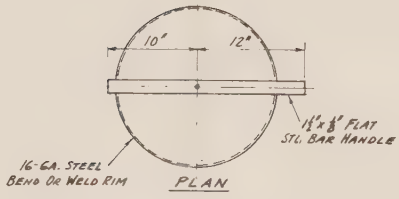

Weld
HOOK FOR COV
2-Req'd.-1-Opp.

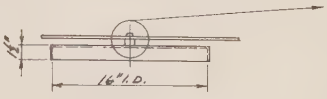


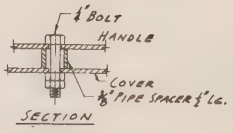


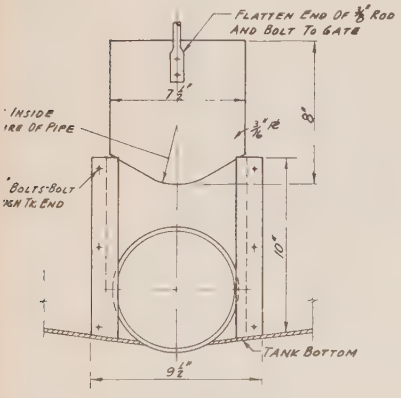




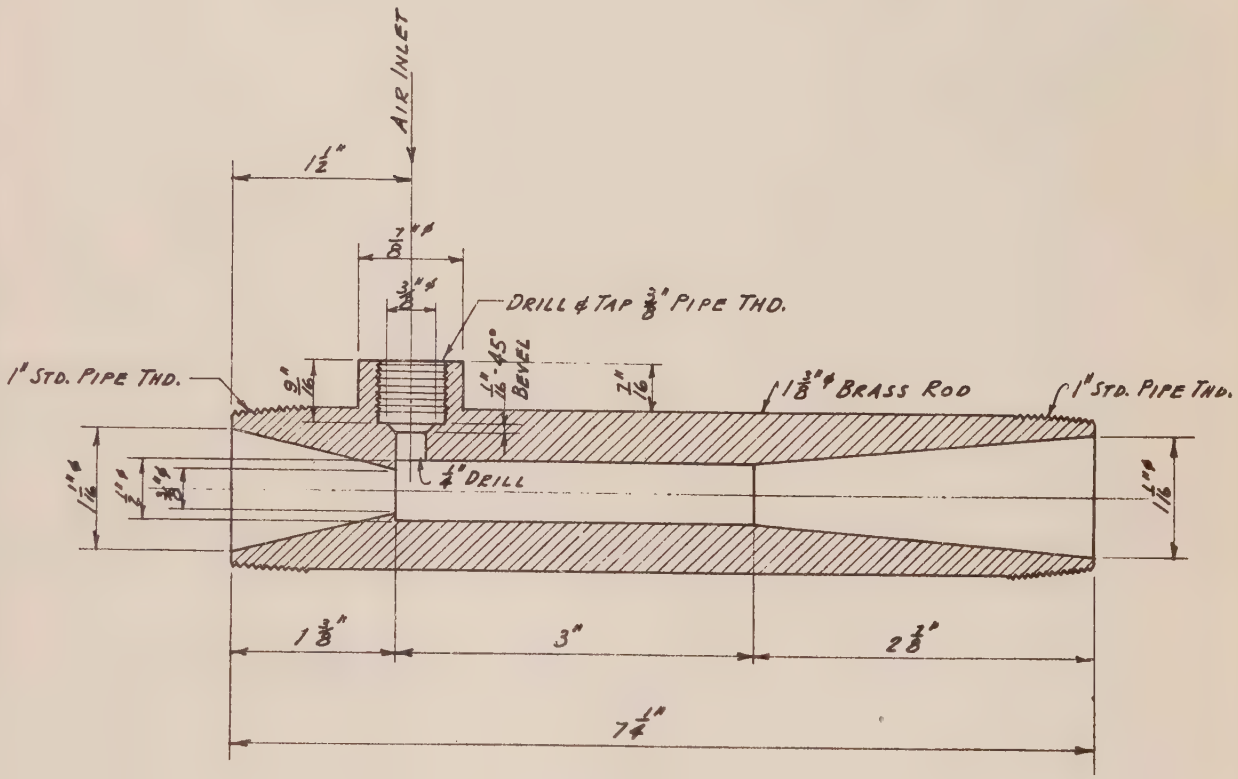






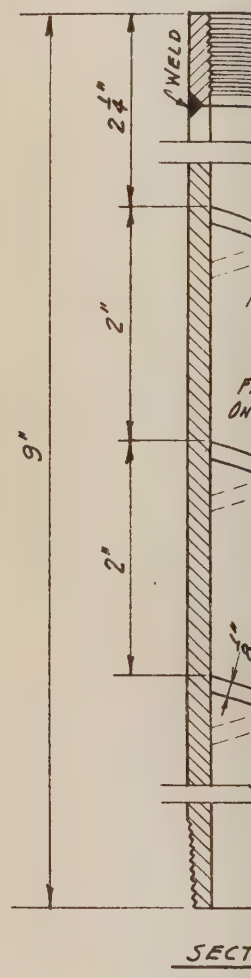


STATE OF CALIFORNIA DEPARTMENT OF NATURAL RESOURCES DIVISION OF FISH AND GAME	
DETAILS OF 150 GALLON AERATED FISH PLANTING TANK	
DRAWN: R.F. SHINE	DATE: 4-3-50

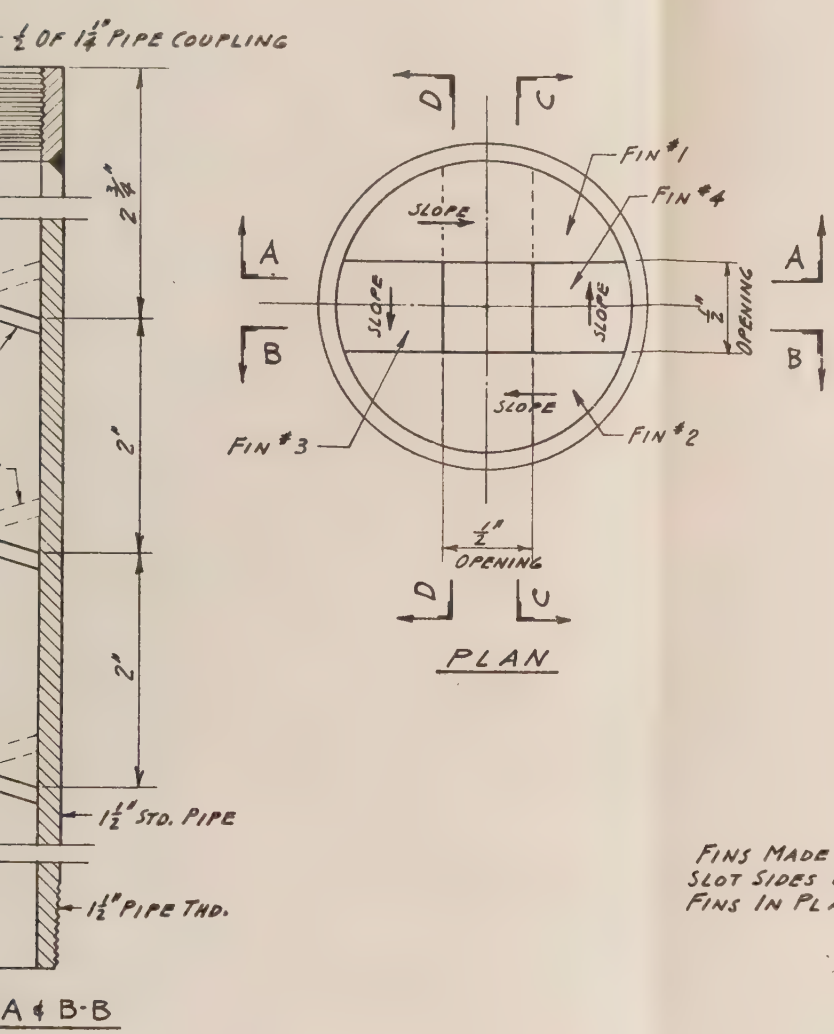


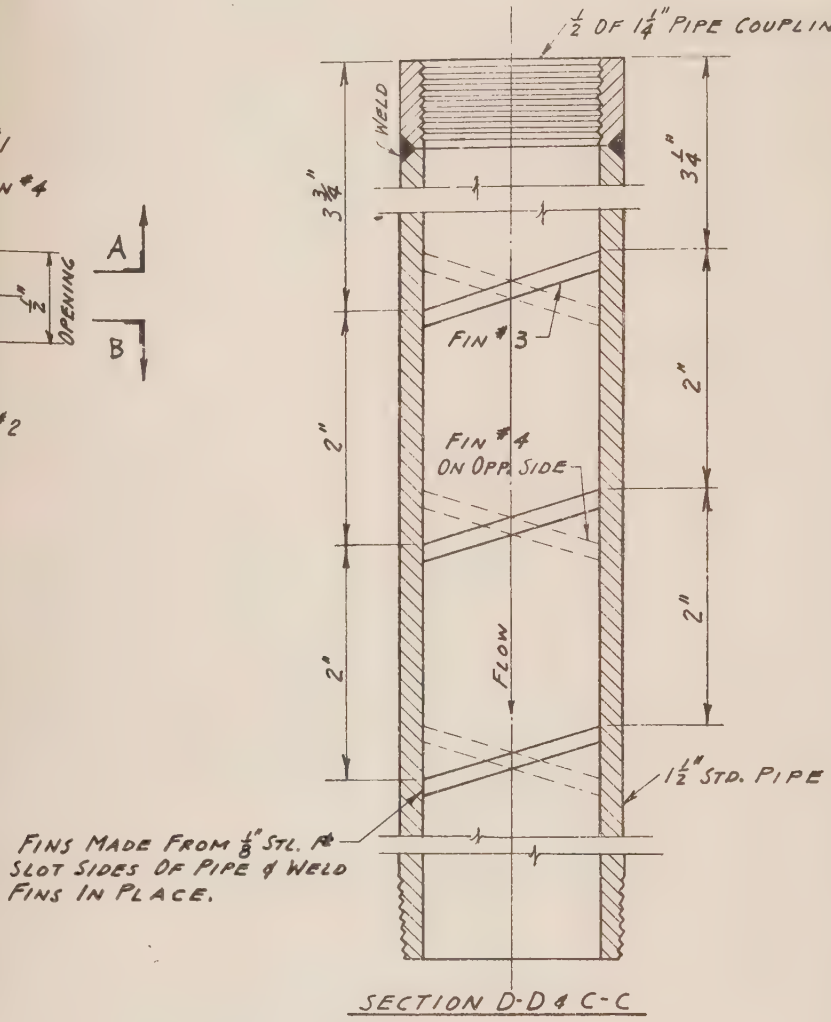
SECTION

AERATOR



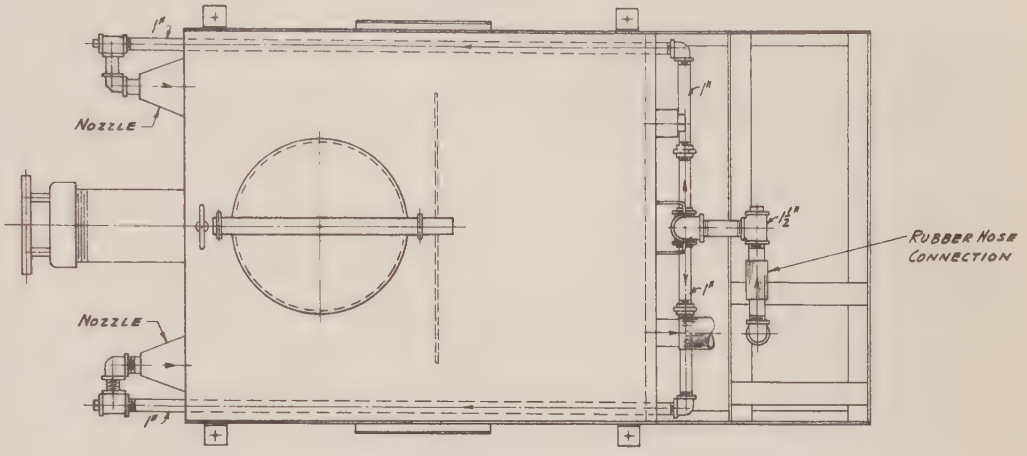
SECT



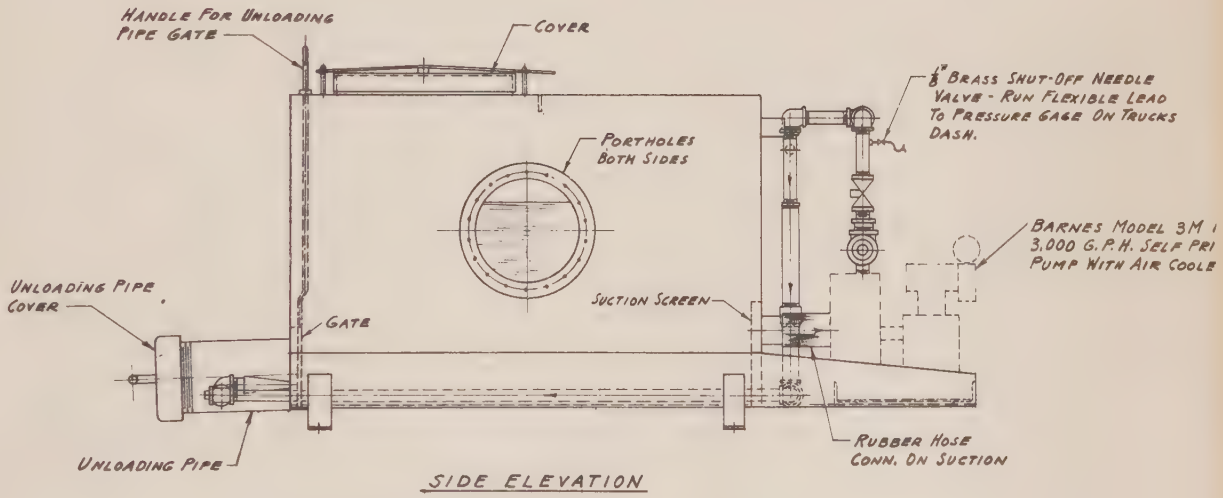


MIXING CHAMBER

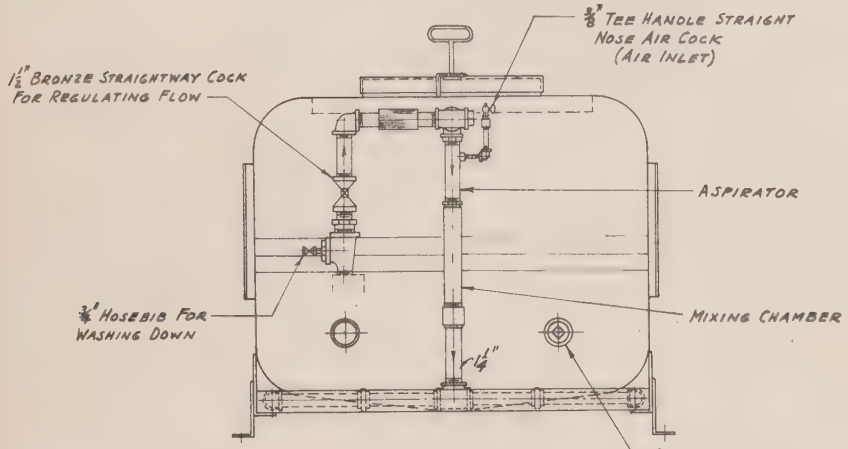
STATE OF CALIFORNIA DEPARTMENT OF NATURAL RESOURCES DIVISION OF FISH AND GAME	
ASPIRATOR AND MIXING CHAMBER FOR FISH PLANTING TANKS	
DRAWN BY: R. F. SHINE	DATE: 4-3-50



PLAN


HANDLE FOR UNLOADING PIPE GATE
COVER
⅜" BRASS SHUT-OFF NEEDLE VALVE - RUN FLEXIBLE LEAD TO PRESSURE GAGE ON TRUCKS DASH.
PORTHOLES BOTH SIDES
BARNES MODEL 3M
3,000 G.P.H. SELF PRI
PUMP WITH AIR COOLE
UNLOADING PIPE COVER
GATE
SUCTION SCREEN
UNLOADING PIPE
RUBBER HOSE CONN. ON SUCTION

SIDE ELEVATION


3/8" Tee Handle Straight Nose Air Cock (Air Inlet)
1½" Bronze Straightway Cock For Regulating Flow
Aspirator
¾" Hosebib For Washing Down
Mixing Chamber
1¼"
1½" Spare Suction Plugg

END ELEVATION

Vo. 25952 1½" Sucт. & Disch.
ming Centrifugal
o Gasoline Engine 1.3 H.P.

STATE OF CALIFORNIA DEPARTMENT OF NATURAL RESOURCES DIVISION OF FISH AND GAME	
150 GALLON AERATED FISH PLANTING TANK	
DRAWN: R.F. SHINE	DATE: 4-3-50

the fish-tail into the tank is made by cutting a slot about 5 inches long and 1/8 inch wide with a cutting torch; the opening is then smoothed down with a flat file to remove burrs or obstructions which might injure fingerlings or interfere with dipping out the fish. The fish-tails are used to distribute the mixture of water and air bubbles forward along the bottom of the tank and obtain maximum aeration by the longest possible travel of the air bubbles through the water in the tank. A small piece of 3/8-inch pipe is attached to the side inlet of the aspirator and brought up to a height level with the top of the tank in order to prevent water from running out of the aspirator when the pump is not being operated.

Following is a list of the materials required in assembling this tank. Descriptions are taken from our requisitions and include some special notes to the vendor.

TANK:	Metal tank to fit "BEAN" Little Giant Duplex Sprayer, Model 4706 MT Capacity 150 gal. Welded steel construction, black iron, NOT PAINTED. Tank to be with manhole cover and base frame members for mounting on pickup truck. Less engine, pump, and all other components	Approx. cost, $125.00
PUMP:	Light-weight automatic centrifugal pump. Barnes "FLASH," Model (3M) 1-1/2" suction and discharge	Approx. cost, 112.00
	2 only, Plastic Sheet, Acrylic, "Plexiglass," size 1/2" thick, 12" diameter (round)	Approx. cost, 17.48
	2 only, Rings, steel, 12" outside, 9" inside, 3/16" thick	Approx. cost, 4.64
SCREEN:	Perforated aluminum plate of 1/16" material, approximately 34" long by 11-1/2" wide, cut and shaped as per template to be supplied by the Bureau of Fish Conservation	Approx. cost, 7.00

MISCELLANEOUS PIPE AND FITTINGS:

2 only	Nipples, 1-1/4" x 6"
1 "	" 1-1/2" x 4"
1 "	" 3/4" x 1-1/2"
4 "	" 1" x 3"
1 "	" 11-1/4" x 4"
1 "	" 3/8" x 2"
1 "	Coupling, 1-1/2"
1 "	" 3/8"
1 "	Elbow, street, 3/8"
4 "	" 1" 90°
2 "	" 1-1/4" 90°
1 "	Cap, pipe, 6"
1 "	Plug, 1"
1 "	" 1-1/4"
1 "	" 1-1/2"

2	"	Tees, 1"
2	"	" 1-1/4"
3	"	Bushings, 1-1/4" x 1"
1	"	" 1-1/2" x 3/4"
1	"	" 1-1/2" x 1"
2	"	" 1-1/2" x 1-1/4"
1	"	Air cock, 3/8"
2	"	Unions, 1"
8	ft.	Iron, angle, 2" x 2" x 3/16"
8	"	" 1" x 1" x 1/8"
8	"	" band, 1" x 1/8"
4	"	" 1/8" x 2"
3	ft.	Rod, iron, 3/8"
1	sq.ft.	Plate steel, 3/16"
12	ft.	Pipe, black, 1"
2	"	" 1-1/4"
1	piece	" threaded one end, 6" dia., 18" long
1	"	Hose, radiator, 1-5/8" x 4"
1	"	" 1-7/8" x 4"
1	"	" garden, 3/4", 10 ft.
4	only	Clamps, hose, "Wraplox"
1	"	Valve, garden, 3/4"
2	sq.ft.	Rubber, gasket, 1/8" thick
16	ft.	Tubing, copper, 3/16", with connections
36	only	Cap screws, 1-1/4" x 5/16"
1	"	Pressure gauge, 2" dial, 0-30#
		Miscellaneous bolts, washers, and small items ..... Approx. cost, 40.00
1	"	Mixing chamber, Div. of Fish and Game ..... Approx. cost, 12.00
1	"	Aspirator, Div. of Fish and Game ..... Approx. cost, 15.00
		Total cost of materials $333.12

The poor productivity of trout in certain lakes in the highlands of the Sierra Nevada range may be due to the rather short growing season at those elevations and to a deficiency in basic mineral elements.

SURVEY OF SYSTEMS USED IN MEASURING LENGTHS AND WEIGHTS OF FISHES, AND OF SYSTEMS PROPOSED AS STANDARD, IN THE SOUTHWEST

Frank T. Knapp
Agricultural and Mechanical College of Texas
College Station, Texas

AT THE 76th Annual Meeting of the American Fisheries Society, Dr. Ralph Hile presented the case for the standardization of expressions of lengths and weights in fish (1948). He favored use of the English system of measurement (calibrated in tenths) and total lengths rather than the metric system and standard lengths.

Because of the interest engendered by Hile's paper, a questionnaire was submitted to 37 fishery workers--in Arkansas, New Mexico, Oklahoma, and Texas--whose names were on the membership lists of the American Fisheries Society and the American Society of Limnology and Oceanography. The questionnaire provided a space for comments and asked the following questions:

1. Are you interested in arriving at a standard method of expressing the lengths and weights of fishes?
2. Have you read Dr. Hile's paper in which the arguments for the English system are set forth?
3. What system do you use at present? Check one. Metric --- English (calibrated in tenths) --- English (conventional) ---.
4. What system would you prefer as a standard for North America?
5. In the interests of standardization, would you be willing to change the system now being used by you to one preferred by the majority of workers?

Of the 37 persons to whom the questionnaire was sent, 10 were teachers or research men in colleges and universities and 27 were administrators, field workers, or hatchery superintendents of state and federal agencies. Therefore, the survey affords an opportunity to compare the responses of the academic personnel with the responses of the nonacademic.

The 22 returns constituted 59 percent of the questionnaires sent out. Of these, 9 (90 percent) were returned by the academic and 13 (48 percent) by the nonacademic workers. One hundred percent of each group were interested in arriving at some standard system of measurement. Seventy-eight percent of the academic workers and 69 percent of the nonacademic workers had read Hile's paper; 22 percent and 23 percent, respectively, had not read it; and 8 percent of the nonacademic group did not answer the question.

Table 1 shows the frequency distribution of measurement systems now being used and of systems desired as a standard by academic and nonacademic fishery workers.

It is to be noted that most of the academic workers use the metric system but are equally divided in their desire to have the metric system or the English system calibrated in tenths as a standard. The nonacademic workers have only a small majority using the English-in-tenths system; they have an even spread over the other systems and a combination of them. This is apparently unsatisfactory, as better than 75 percent of these workers are in favor of standardizing the English-in-tenths system. This is understandable, as they are using more systems than the academic persons and yet must present to the public reports which are readable. The English-in-tenths system eliminates to a high degree the mathematical diffi-

TABLE 1.--Measurement systems now in use and systems desired as a standard by academic and nonacademic fishery workers in the Southwest

(Figures represent percentages of each group.)

Group	System in use: Metric	English (tenths)	English (conv.)	Both
Academic	89	11	-	-
Nonacademic	15	39	15	23* and 8**
Combined (unweighted)	45	27	9	14* and 5**

Group	System desired as standard: Metric	English (tenths)	English (conv.)	Undecided
Academic	44	44	-	12
Nonacademic	15	78	-	7
Combined (unweighted)	27	64	-	9

* Both metric and conventional English systems.
** Both English-in-tenths and conventional English systems.

culties associated with the conventional English system yet is readily understood by the public. Combining the two groups, it may be seen that a small majority use the metric system at the present time, but that a considerable majority favor using the English-in-tenths system as a standard.

Considering the final question (regarding willingness to change from the system being used at present to the one favored by the majority), 78 percent of the academic group agreed to do so, 11 percent refused, and 11 percent were undecided. This is in contrast to the nonacademic group, who were unanimous in their willingness to change. Combining the groups, it may be seen that 91 percent agreed to abide by the majority rule.

The comments made by the various responders are of considerable interest and may be summarized as follows:

1. The majority of individuals expressed a desire to arrive at a standard system regardless of what that system might be.

2. If the English-in-tenths system is finally adopted as a standard, measuring devices with inches calibrated in tenths, and pounds in hundredths, should be made available as soon as possible at a reasonable cost.

3. The metric system should be retained for technical publications of international nature.

4. Public understanding of fishery reports is the main reason for the selection of the English-in-tenths system.

It should be noted that this survey covers a section of the country having few fishery workers and these are apparently very much subject to public opinion regarding their work. This may account for the strong desire here to adopt the English-in-tenths system. Further, as the number of replies is small, the results of this survey should not be construed as representing anything other than a general expression of opinion by fishery workers in the four States studied.

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FISH GROWTH RATES READ DIRECTLY FROM THE PROJECTED SCALE

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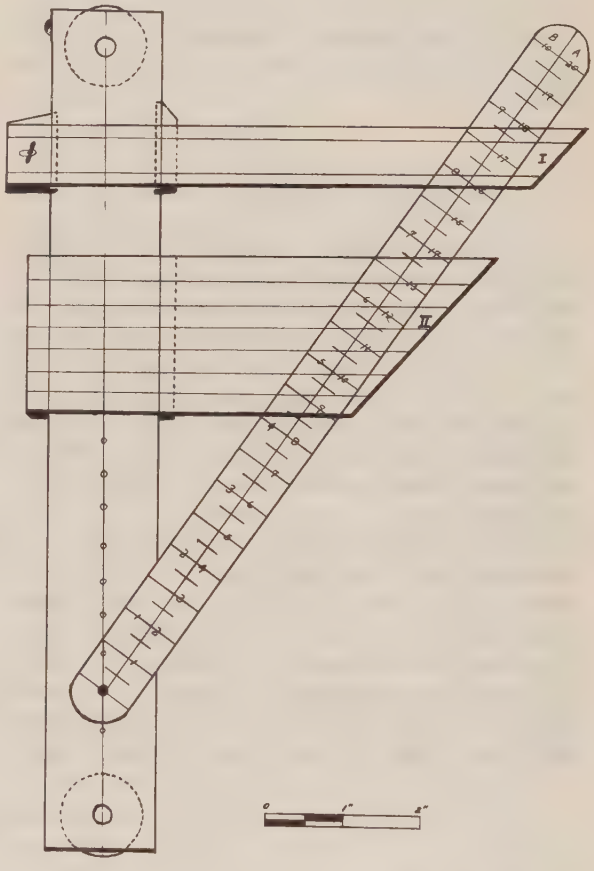
Kentucky Division of Game and Fish
Frankfort, Kentucky

THE SLOW process of measuring a large number of scales and then calculating the rate of growth for each fish has been a very undesirable job, but it has been speeded up a great deal with a measuring device being used by the Kentucky Division of Game and Fish. The material for constructing the measuring device can be purchased for very little money, and little time will be needed for its construction.

This device eliminates the calculations necessary to determine the rate of growth of many of our fishes as long as the direct proportion calculation is used. The attachment is suitable for use on any glass-covered microprojector screen. The measurements with this device can be made almost as quickly as the scale measurements are taken for calculation later. The chances for mathematical errors are greatly reduced.

This attachment (see figure) is made of 1/16-inch clear plastic and can be constructed very easily from any soft plastic. Plexiglass or similar substance can be used, but these materials are much more difficult to work with during the construction.

The construction can be simplified if the two cross bars, I and II, are made to fit the center or base strip (which has two suction cups) and the parallel lines on these bars are then drawn at right angles to the single line on the base section. A drafting triangle can be used to draw the lines perpendicular to the single line on the base strip. All lines are easily placed on the plastic with a straight edge and any sharp-pointed object. After the lines have been made, they can be covered with ink or any other coloring substance and then the entire surface can be wiped clean. If the lines



(Courtesy of author)

are narrow, the coloring material will remain in the line and thereby facilitate reading. If the lines on bar II are made in two contrasting colors alternated from top to bottom, the device is more conveniently used.

The graduated rule can be made from any plastic of equal or lighter weight and can be made to suit the user. The center line on the rule can be divided into millimeters on one side and inches on the other, or one rule can be made

in inches and another in millimeters.

Column A on the right edge of the rule shown in the figure is marked and numbered in inches. Column B is numbered in 2-inch divisions. This enables the user to read several species of fish scales without changing the magnification of the machine.

A small pivot, made from a nail head and about 1/8 inch of the nail and cemented into the graduated rule, enables the user to move the rule from one hole to the other. The long series of holes in the base makes it easier to set the pivot of the rule over the focus of the scale.

Operation

After the scale selected for measurement has been projected on the projector screen, the base section, with the two perpendicular arms attached, is placed over the projected scale image with any one of the small holes in the base section over the focus of the scale and the single line in the center of this section approximately parallel to the primary radius.

With the base section in place, the movable bar I is moved up or down until one of its parallel lines is just touching the outer edge of the scale. Then the bar I is locked in place with the thumb screw and small piece of plastic in which it is set. Bar II is next moved until any one of its lines is just touching the first annulus.

The pivot on the graduated rule is then placed in the hole over the focus of the scale, and the tip of the rule is moved to the right from the base section until the intersection of a line on the rule and the bar-I line that is in contact with the outer edge of the scale corresponds to the total length of the fish. After this has been done, the rule is held in place with one hand and the free hand is used to move bar II in order that one of its lines may be lined up with the outer edge of each annulus. The intersection of the line on the rule and the line on bar II that is in contact with any annulus, gives the amount of growth for that annulus. The width of bar II makes it easier to keep that bar perpendicular to the base section, and the large number of parallel lines makes much less movement necessary--usually only a small amount of movement is necessary after the first annulus has been lined up.

Column B on the left side of the rule is used for all growth readings when the primary radius of the projected scale is longer than the total length of the fish. It is not usually necessary unless several species of fish are being measured during a short period of time. Column B may be omitted if the projector has several lenses and the size of the image can be changed readily. Whenever possible, the primary radius of the projected scale should be less than the total length of the fish.

DISTRIBUTION UNITS FOR WARM-WATER FISH

Albert J. Wilson
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Welaka, Florida

ONE PROBLEM with which a hatchery superintendent is frequently faced is that of the construction or renovation of a distribution unit. Experience from time to time weeds out certain objectionable features and suggests new desirable features to be incorporated in a new or different unit.

In planning the construction of a new unit, several factors must be considered and a number of questions answered. Among these questions are: How many fish will it be necessary to carry on a trip? Will fish be delivered in small lots in different places (as for farm ponds) or in large lots--say a truck-load--to one location (as in the case of larger bodies of water)? How can we manage the problem of removing the fish from the unit? What size truck is most practical for carrying the unit? Can a truck be kept busy the year round on distribution work, or will it be necessary to use the truck for other work during certain seasons? What is the cost of construction and operation of a new unit? Any experienced hatcheryman could add to the questions I have listed here, but for the moment these will serve as a sample of the problems to be considered.

Construction and Mounting

For work with warm-water fishes in the Southeast, I have found the demountable tank the most satisfactory. The tank we have constructed most recently is 3½ feet wide, 8 feet long, and 2 feet 8 inches high. The four compartments run the width of the tank and are 22 inches wide. We ordinarily use about 2 feet of water in the tank, allowing approximately 8 inches freeboard beneath the cover. The entire tank carries approximately 350 gallons of water weighing about 1½ tons, an ideal load for the 1½-ton long-wheelbase truck.

The tank is mounted so that most of the load is forward of the rear wheels, and, where possible, the distribution is planned so that the rear compartment is unloaded first. Keeping the weight far in advance of the rear wheels reduces splash and surge, minimizing damage to fish and loss of water.

A number of materials may be used for construction, and several methods of assembling the materials are satisfactory. Welded sheet steel is used with good results, but this material is rather heavy and requires considerable maintenance in the way of painting and rust prevention.

The tank referred to above was made of 24S-T aluminum alloy and riveted together. This is the most satisfactory material and the best construction method I have ever tried. Such a tank requires a little more work than a welded tank, but the result is a strong, light, flexible unit which, I believe, will last as well as or better than the sheet-steel tank.

The aluminum material is itself a good reflector. Subsequent application of aluminum paint is not necessary from this standpoint. As a good deal of our hauling is done in temperatures above 70° F., the reflection of the sunlight is an important factor to consider. We have determined that an aluminum-colored tank will run considerably lower temperatures than one painted black or green. I recall starting out once at 6 a.m. with water at 85° F., making an 8-hour trip during which the air temperature reached 96° F. on a bright day. At the end of the run, the water

temperature in the tank had dropped to 72° F. It is my belief that this reduction in water temperature was caused by the action of the aluminum in reflecting the sunlight as well as by evaporation.

Aeration

When carrying fish in numbers larger than the normal oxygen content of the water will support, it is necessary to supplement the supply of oxygen obtained by the motion of the water in transit. The three methods commonly used are the compressed-air method, the canned-oxygen method, and the circulating-spray method. All of these methods have certain advantages and disadvantages.

The compressed-air method apparently satisfies the oxygen requirements of the fish during transportation. It has the disadvantage, however, of requiring a compressor and some type of electric motor or gasoline engine which is subject to mechanical failure. Also, it does not help to eliminate the carbon dioxide, and in our climate the compressed-air method assists in raising water temperatures through the introduction of warm air into the tanks.

The canned-oxygen method is probably the simplest to install and gives little trouble from mechanical failures. It is effective in maintaining sufficient oxygen, and its operation is not hampered by trash, moss, or algae in the water. It has a negligible effect upon the water temperature. The disadvantages of the method are that it does not eliminate carbon dioxide, it is generally the most expensive of the three methods to operate, and there is a possibility of charging the water too highly and giving the fish an "oxygen jag."

The circulating-spray system--removing the water from near the bottom of the tank and pumping it back through the air from the top of the compartment into the water--has the advantage of maintaining the oxygen supply, eliminating the carbon dioxide, and cooling the water through evaporation. Apparently, the hotter the day, the more pronounced is this cooling effect. The cost of operation is about the same as for compressed air, but the spray system, too, is subject to mechanical failure, and the necessity for using only clean water--that is, water that is free from trash, moss, or algae--can often be a decided disadvantage.

One way to avoid major trouble caused by clogging of screens and pipes is to install the drain in the side of the tank near the bottom rather than to pull the water from the bottom. Dead and injured fish, grass, and heavier debris will settle around the outlet screen; by placing this outlet a few inches above the bottom, most of this debris can be avoided. A large suction outlet is desirable so that the current produced by the removal of water is not concentrated. Too much pressure on the spray system can result in injury to fish as well as in making the water foam. I have found approximately 7 pounds of pressure to be sufficient. In my opinion, the ideal aeration system would be one which combined the circulating spray with canned oxygen. If I were forced to depend upon one alone, however, I believe the circulating spray would get my vote.

Load and Mortality

Naturally, the first thing an operator of a distribution unit must know is the load capacity of his equipment. Just how heavy can he load under different temperature conditions and for different lengths of delivery time for the various species and sizes of fish which he carries? The table offers a load ratio, based on about average operating conditions in the Southeast, for use with warm-water fishes. We try to follow this table, varying the loads with the air and water temperatures in which we are working. Experience indicates that attempting to handle fish in water above 80° to 85° or below 40° F. usually results in high mortality.

Another factor which must be considered in determining loads is one which I have not heard discussed too much. This is the space factor. It is my opinion that this factor plays an important part in determining how heavy fish can be carried in distribution without injury through finning or rubbing during transit. This factor was taken into consideration in

Numbers and weights of bass, bluegill, and other sunfishes per gallon of water which can be carried safely in units using circulating spray or canned oxygen, in water temperatures between 65° and 85° F.

Size	Weight of fish per gallon	Approximate number of fish per gallon
1 inch	1/3 pound	333
2 inches	1/2 pound	200
3 inches	2/3 pound	67
4 inches	1 pound	25

the preparation of the table.

The question is commonly asked, "How many fish are lost in transit?" With healthy fish in good condition when they are loaded, there is no mortality on the average trip. Generally some fish are injured in handling during loading and unloading, but this loss should not be more than 1 percent.

If it is possible to estimate the temperature of the water into which the fish will be placed, it is a good idea to try to do the tempering enroute, rather than after arrival. Each operator with sufficient practice can control somewhat the temperature changes which occur in his load on the way. I believe that ice in transporting warm-water fish is very seldom, if ever, necessary and should be used only in small amounts under extraordinary conditions. At the other extreme, the operator should either cut to a minimum or eliminate the circulating spray, use a small amount of oxygen, and exercise all precautions to prevent cooling of the water during cold weather.

Fish distribution is at best a tricky thing when the operator is trying to get the maximum use from available facilities. A good deal of thinking, planning, and profiting by your own and others' experience in handling fish can result in the elimination of a great many headaches in the use of a distribution unit.

The argument as to whether fish can or cannot see color has led to experiments based upon the theory that the eyes of fish are adapted to see ultraviolet rays that do not register in human eyes. From very inconclusive work with ultraviolet-activated materials, it has been suggested that the color range seen by fish may lie between that of a bee and a human being, that most insects of interest to fish give off colors in these wave-lengths, that fish in bright daylight and with their eyes in bright light can see no color, and that during the darker or "shadow" hours of the day fish are well able to distinguish bright colors within the human range.

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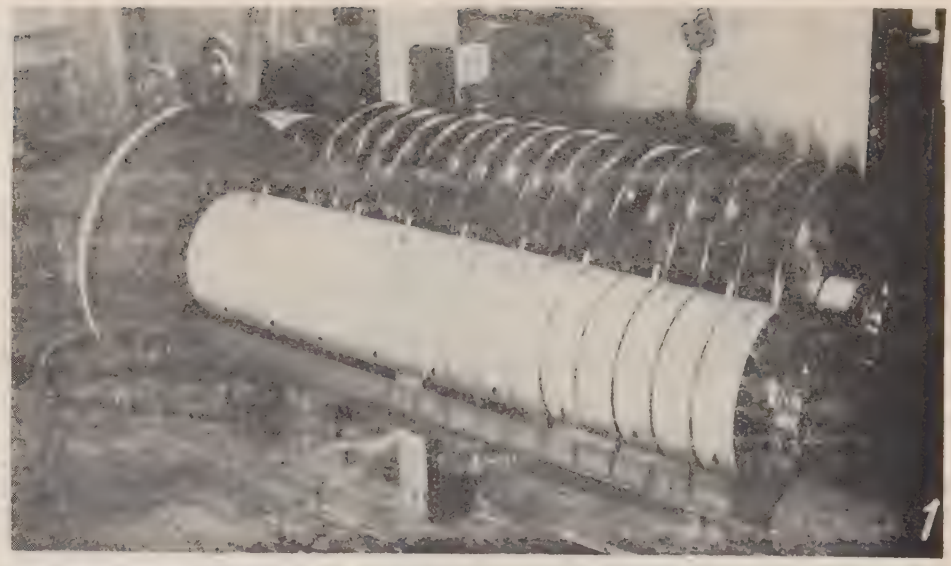
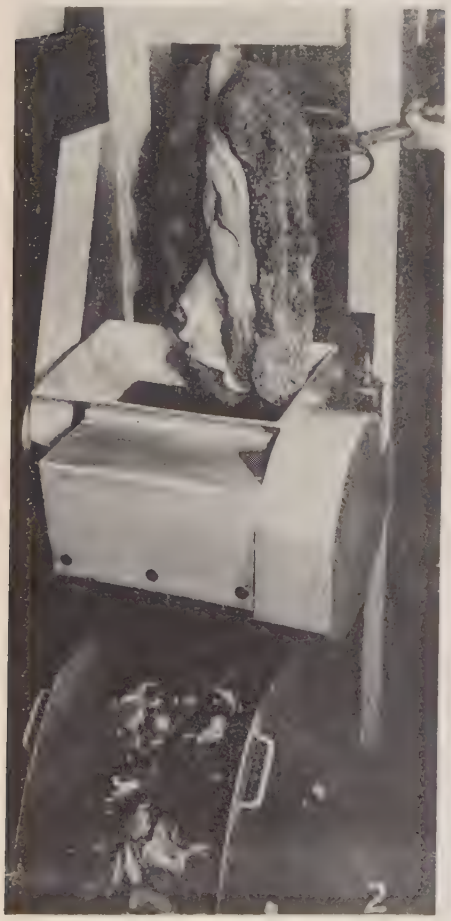
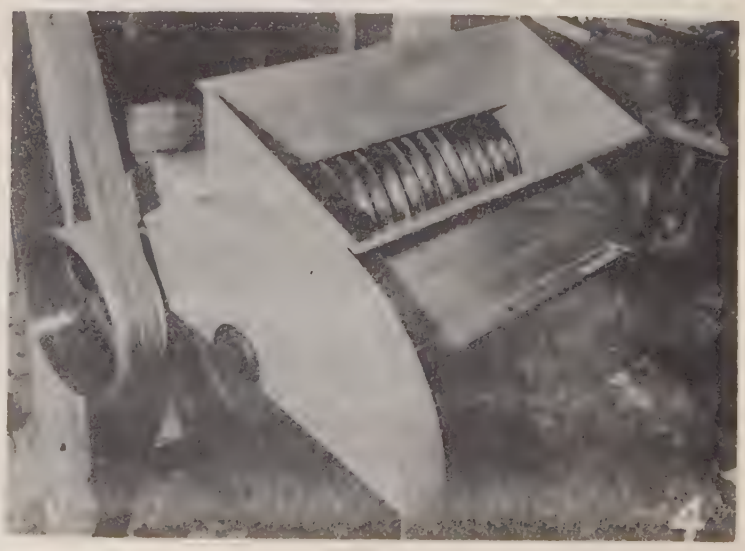
1) Cutting discs, impeller drum of large machine.

2) Original four-blade machine receiving beef tripe.

3) Close-up of the power transmission, r.p.m. relation between cutting discs and impeller drum.







4) Protective cover and hopper on large machine. All later models are equipped with 4-belt V pulleys.

THE CHIPMAN MEAT CUTTER

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U. S. Fish and Wildlife Service
Hagerman, Idaho

THE Chipman Meat Cutter was designed and constructed by the writer in 1945, while he was superintendent of the U. S. Fish-Cultural Station at Bozeman, Montana.

This machine was built for the sole purpose of reducing large chunks or pieces of meat or fish into small pieces of the correct size to be put directly into the grinder, thus to eliminate the long old-fashioned process of using a butcher knife or cleaver to hand-cut the meat before it could be ground and ready for feeding. Aside from being one of the most undesirable jobs around the hatchery, cutting the meat by hand consumed the major portion of the time necessary to prepare the meat for feeding.

This meat-cutting machine will reduce meats to a size suitable for the grinder in about one-tenth of the time required when the job is done by hand. With the small original model that had four cutting blades, it was possible to cut up 2,600 pounds of meat in an hour. With a butcher knife, one man can cut up, on an average, about 225 pounds of meat an hour or 2,000 pounds in an 8-hour day. As the machine will do this in less than an hour, the hatcheryman is thus enabled to devote the other 7 hours to other work necessary to the operation of the station.

The working capacity of the machine is measured more accurately by how much meat a man can scoop or fork into it, rather than by how fast it will cut up the meat. The size of the machine can be made to fit the needs of the individual hatchery. A model using 7 blades has been built, and the machine now in operation at the station at Hagerman, Idaho, has 17 blades.

Construction of the machine is simple. There are only two major moving parts, the circular knife assembly and the impeller drum with knife guides. Because of the hardness of the high-carbon steel knives, they seldom require sharpening; but they may be sharpened without being removed. The knives revolve at 600 revolutions per minute, while the impeller drum revolves in the opposite direction at only 75 revolutions per minute--or a ratio of approximately 8 to 1. Knife guides in the impeller drum prevent the knives from weaving under heavy cutting loads. The impeller drum is fitted with studs to carry meats through the blades. Because of the difference in the speed of the drum and of the knives, these studs actually hold the meat back and allow the knives to make several revolutions through the meat; thus the meat is cut as it comes in and does not choke or clog the machine. The later models have the cutter powered by a 5-horsepower electric motor mounted overhead with three V-belts which are enclosed in a sheet-metal jacket. All bearings are of the sealed roller type which may be lubricated with a grease gun.

The metal hood that covers the machine has a bunker-type opening into which the meat is shoveled. All pulleys and belts are covered to prevent accidents. All protective measures have been taken, and the meat-cutter is considered to be as safe an operating machine as is employed in the feed-preparation room.

Aside from the time-saving factor, adaptability to the station work load, ease of construction, and safety measures, this machine has other advantages, such as its low cost. The cost of this meat-cutting machine is less than that of any of the other equipment needed for an efficiently functioning meat-preparation room.

RESEARCH ON THE SEA LAMPREY

A research contract has been awarded by the Fish and Wildlife Service to the Cook Research Laboratories of Chicago for the development of electric, electronic, and electromagnetic devices for the control of the destructive sea lamprey. Under the terms of the contract, the first experimental installation will be made in the Carp Lake River in northern Michigan in October 1950, and a second and different type of device will be installed for tests beginning in April 1951.

In addition to that type of control, a Burkey electric fish screen will be installed under the inventor's direct supervision and will then be operated by the staff of the Great Lakes Fishery Investigations.

A new 60-foot vessel, construction of which is scheduled to begin in the immediate future, will make possible the study of certain little-known aspects of the sea lamprey's life cycle. Also, from this floating laboratory it will be possible to experiment on methods of capturing and destroying the lamprey during its lake life (especially in fall and winter, when this parasite appears to be concentrated off the mouths of streams), to conduct test-netting as a check on the abundance of lake trout and other species, and to collect badly needed data on the biological, physical, and chemical conditions affecting the distribution and abundance of lake trout and other fish.

A prejudice existed in the public mind for a time against raising brook trout for public waters. This was regarded as interfering with private trout breeders and tending rather to the encouragement of sporting than to the increase of the supply of fish food. But this prejudice has been overcome. The advantages of some healthful and exhilarating out door amusement are pressing themselves more and more upon a nation of hard working men, who are confined day after day, and often half the nights, at the desk or in the counting room, and who suffer to so large a degree from paralysis and softening of the brain.

--R. B. Roosevelt and Seth Green, "Fish hatching and fish catching." Rochester, 1879.

QUICKLY CHANGED DIP NET

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U. S. Fish and Wildlife Service
San Marcos, Texas

DIP NETS are among the indispensable tools around a fish-cultural station. They are made in a number of different ways and in various shapes and sizes. Keeping these nets in good condition has always been somewhat of a problem. Because of the hand work involved, the job of repairing or replacing dip-net bags is time-consuming and consequently expensive. This is especially noticeable when nets play out at critical busy periods and personnel can ill afford to take time to repair them.

At the U. S. Fish-Cultural Station at San Marcos, Texas, there has been developed a dip net which is believed to be superior to any of the dip nets ordinarily found at fish-cultural stations. The bag of this net can be changed at any time and in a very few minutes. The dip net can be made with square corners or of circular shape; it can be made in any size desired. All hand sewing has been eliminated.

For an example, an 8-inch square net will be described. This net can be made from a piece of bronze welding rod 3/16 of an inch in diameter and 3 feet long. The rod is bent to shape and a handle is attached. The corners are made square and sharp.

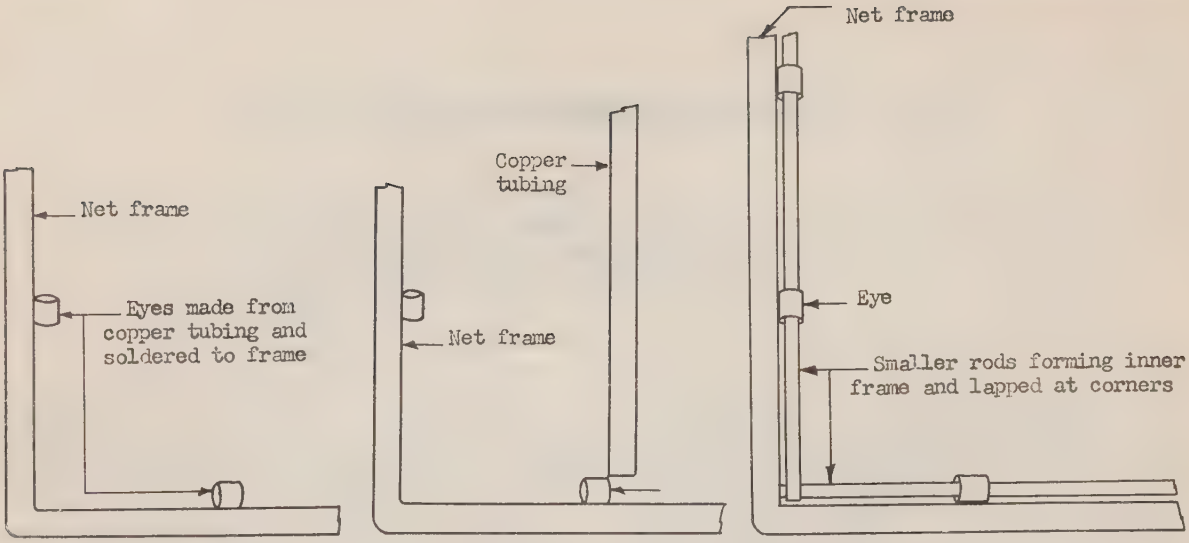
Twelve eyes are soldered to the inside of this frame. On each lateral, three of these eyes are so spaced that one eye is 1½ inches from each corner and the third eye is in the center. The eyes are simply pieces of 3/16-inch copper tubing cut to a length of about 3/16 of an inch. (See figures 1 and 2.) Hard-drawn tubing is best if it is available. Figure 2 shows an easy way to solder eyes to the frame. The tubing is cut almost through, and then the eye part is bent at right angles to the rest of the tubing. This leaves the unused tubing to serve as a handle by which to hold the eye while it is being soldered to the frame.

Another piece of bronze welding rod, 3/32 of an inch in diameter, is cut to four lengths so that each length will fit from inside corner to inside corner of the frame. Each piece of the 3/32-inch rod can be threaded through the three 3/16-inch eyes soldered to each side of the frame. The rods will fit inside the frame and stay snugly in place; they are allowed to lap at the corners, as shown in figure 3. The complete frame now consists of the outer frame with eyes soldered to it and the inner frame of four pieces of rod going through the eyes and fitting inside the outer frame.

The bag for the frame is made by cutting a piece of bobbinet (or other netting material) the size to give proper depth to the bag. An extra inch is allowed so that a ½-inch hem can be sewed on each side of the bag. All hems are sewed by machine and double-stitched for strength.

If the bag is to be 3 or 4 inches deep, tapered corners will be desirable. About 1 inch of the netting material is turned in and stitched (see figure 4); when the ½-inch hem is folded, it will form a good-looking corner with a biased opening and added strength (see figure 5).

The next step is to proportion the distance along the hem and cut a small slit where each eye is to fit. (See figures 5 and 6.) A 3/32-inch rod can then be threaded into each side of the bag, proceeding from a corner, through a section of the hem, between the slits, and then through an eye. As soon as the four sides are threaded, the net is completed.



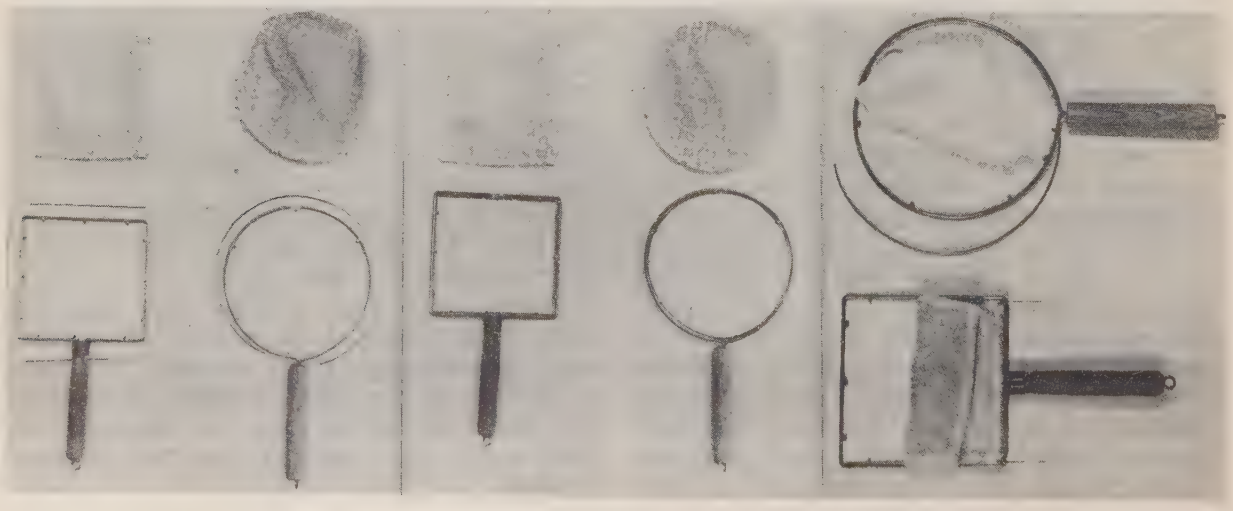
FIGURES 1, 2, and 3.

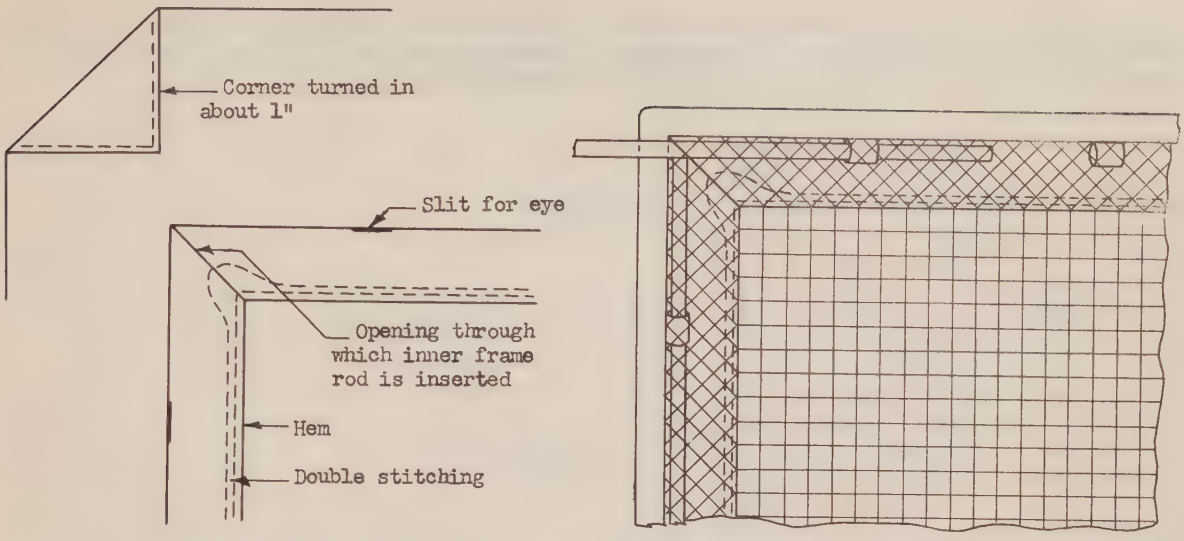
Circular nets are made in the same way as square-cornered nets except that the welding rod is bent in a circle. Eyes are soldered to this every 4 or 5 inches. The 3/32-inch rod is bent to the curvature of the outer frame and then threaded through the eyes. Friction will hold it in place.

Figure 7 shows the component parts of a square net and a circular net; figures 8 and 9 show the nets partly assembled; figure 10 shows them fully assembled. Figure 11 offers a variety of circular and square-cornered nets.

Larger nets require larger framing material. For a 20- by 28-inch net, 3/8-inch steel rod was used. Brazes were made on this rod 2 inches from each corner and at 4-inch intervals along the sides. A ¼-inch copper eye was soldered at each braze. The inner frame was made of 1/8-inch welding rod, which fitted nicely inside the copper tubing. A circular net 2 feet in diameter was made the same way. On large circular nets, galvanized wire or copper wire can be used for the inner rod. Wire taken directly from a coil will be found to have

FIGURES 7, 8, and 9.





FIGURES 4, 5, and 6.

approximately the desired curvature.

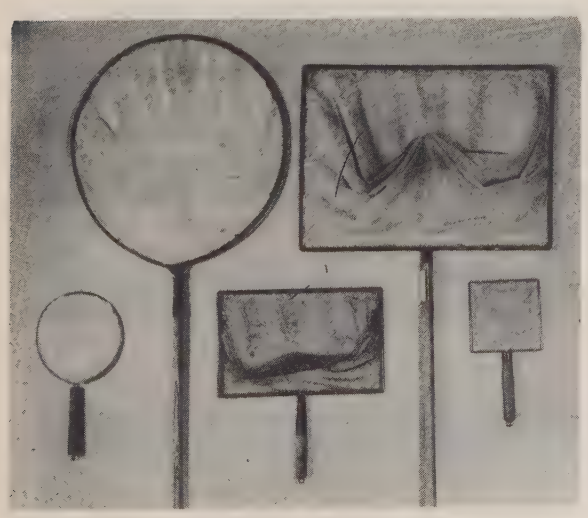
Some experiments are being made with nylon netting material for bags of fine mesh, and the results have been encouraging. Water passes through nylon netting well, and the material seems to be holding up much better than some of the bobbinet obtained recently.

This quick-change dip net has a number of advantages:

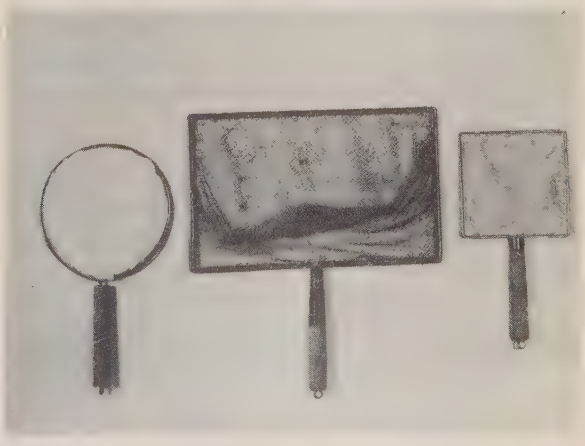
1. The great saving of time and expense, both direct and indirect, in keeping nets in repair. From 1 to 3 man hours of labor can be saved each time a net must be rebagged. An 8-inch square net, an 8-inch circular net, and a 20- by 28-inch net were completely rebagged in 2 hours. This task would require a full day's work by the conventional method of hand sewing and hand binding.

2. Elimination of all hand sewing. The bags are completely sewed by machine before being put on the frame. This means that bags can be sewed ahead of time and in quantity, effecting another saving. When bags are on hand, the actual changing requires only 10 to 15 minutes.

3. Longer life of net. There is always a metal wearing edge. All types of binding--such as canvas, inner tube, copper wire, rawhide, and other materials--around the edge have been eliminated.



FIGURES 10 and 11.



4. Possibility of standardizing size and construction of nets. Bags could be made up in some centrally located place and sent to stations on order. Further reductions in costs and time could be effected in this way.

MOTOR DIRECTIONAL SWITCH

An inexpensive motor "directional switch"--used in conjunction with the motor switch and thus eliminating the possibility of accidentally starting the motor in the wrong rotation--has been recommended by L. D. Winslow, hatchery foreman at the New York State Fish Hatchery, Bath, New York. Winslow reports that he based his work on a sketch and outline shown in Popular Mechanics Shop Notes for 1950. This may be consulted in the average library or ordered direct (volume 46, $1) from Popular Mechanics Press, 200 East Ontario Street, Chicago 11, Illinois.

Operating in 42 States, 95 Federal fish hatcheries produced during 1949 more than 55,356,000 eggs, 587,163,000 fry, 106,530,000 fingerlings less than 6 inches in length, and 1,518,000 fish 6 inches or more in length. Thirty-four species of fish were propagated, representing more than a dozen of the most important commercial food fishes and almost all of the more valuable game and pan species found in this country.

PUBLICATIONS

REPRINT

SALMON (Salmo salar L.) WITH NO ADIPOSE FIN

by Gunnar Svärdson

When a large number of fingerling salmon were marked by fin-clipping in autumn 1948 at the Hyttö pond at Älvkarleby in middle Sweden, some fingerlings were found which were naturally lacking an adipose fin. They were discovered in the routine course of marking operations, when the fingerlings' ventral as well as adipose fin was being cut off.

About twenty-five specimens altogether were discovered in 60,000 yearling salmon handled. Mr. Gösta Molin, who realized their theoretical interest, is acknowledged here for his delivery of the live abnormal fish to the Institute of Fresh-Water Research, Drottningholm.

Most of the young salmon without an adipose fin show no traces whatsoever of the lost fin (fig. 1). No injuries or scars are seen. Some few, which are alive and therefore have not been carefully studied so far, have some traces of the fin, showing itself as a small enlargement of the region where the fin should be placed.

The abnormal young salmon have good vitality and deviate, as far as can be judged, in no other respect from normal ones.

The evidence at hand suggests this absence of adipose fin to be due to a mutant gene, which is by chance homozygotic out of two heterozygotic parents. As all fingerlings were put into the pond as fry, nothing can now be said about the appearance of their parents or the true ratio in which they occurred.

Some specimens have been killed for investigation, but all the others are still alive. It is thought to make an attempt to keep them alive in order to get offspring from them. This is, of

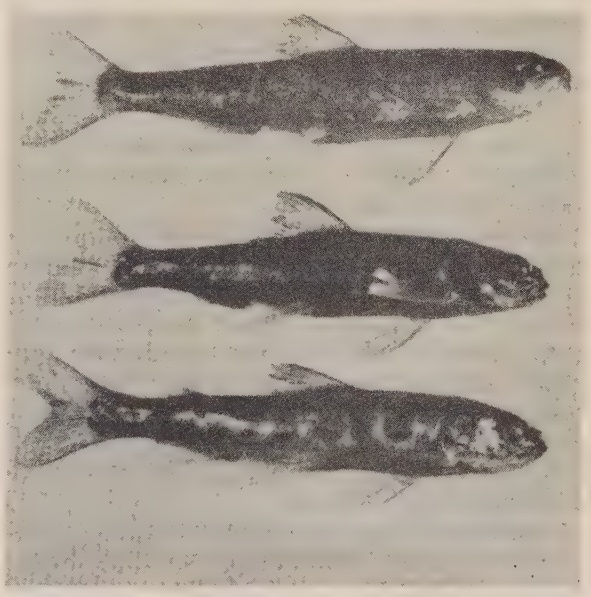


Fig. 1. Normal (below) and two mutant salmon fingerlings with no adipose fin. The colour difference is an artifact, due to later preservation of the normal fish.

Reprinted from Annual Report for the Year 1948 and Short Papers. Fishery Board of Sweden, Institute of Freshwater Research, Drottningholm, Rpt. 29, 152 pp. Lund, 1949.

course, a long-term programme which no doubt will meet with considerable difficulties, owing to the slight chances of getting salmon to mature in fresh waters, apart from young males. Formerly some few females have been reared to maturity at the experimental station at Kälarne, but that took some 5-8 years, and the losses during this time were of course very high.

There is a considerable theoretical as well as practical interest with these young salmon. It would be very valuable and interesting if it could be definitely proved that this phenotypic character is due to a recessive gene, but the evidence now at hand makes this interpretation most probable. Those fish having traces of the lost adipose fin, of course, could be the result of modifying genes, or, which is probably more significant, the loss of the adipose fin could be due to some physiological process which does not give rise to identical phenotypic expression in all fish.

From a practical point of view, it would be interesting if there were possibilities of rearing a population without an adipose fin, which could be introduced into salmon rivers in known abundance and their propagation and population turnover studied. Moreover, fry from this eventual strain could be used as a test strain for the routine plantings of fry into diverse salmon rivers.

Genetically it is interesting to find that this mutant interferes with the diagnostic character used in fish taxonomy to separate Salmonidae from Clupeidae within the order of Malacopterygii (Clupeiformes) when the taxonomy of Gaschott is followed (Gaschott 1928). It is interesting to find the genetic instability of a character used as some phylogenetic clue, as has formerly been demonstrated for Drosophila's second wing pair.

Neresheimer (1937) states that so far nothing is known about any function of the adipose fin. It is built up of fat and connective tissue, and he points out that it contains elastoidin-fibres like the fin edge of Selachoidea and Dipnoi, which might possibly indicate that the adipose fin could be a rudimentary organ. From a genetical point of view, however, a "rudimentary" organ certainly also has some more or less vital function if it is still left. Also, the normally stable form and frequency of the adipose fin within Salmonidae indicate a function of its own. It may therefore be suggested that the loss of adipose fin in these presumed mutant young salmon must most probably lessen their general vitality. But so far nothing of that kind has been observed in the laboratory, and until I have more of them, I am not inclined to risk losing them by exposing them to competition from normals. Of course, their vitality must be tested against normals before they eventually can be used as "fry-tagged" fish in planting experiments.

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We should like to receive similar reports of malformation on trout or salmon in this country.--The EDITORS.

GREEN BAY WALLEYES

A REPORT ON THE SCIENTIFIC INVESTIGATION OF THE MARKED INCREASE OF WALLEYES ON GREEN BAY

Ralph Hile

During recent years of general preoccupation with problems created by the spread and increase in abundance of the sea lamprey and the accompanying decline of the lake trout in Lakes Huron and Michigan, certain developments in the Great Lakes fisheries that normally would have been given wide publicity, have received little more than local notice. Among these developments may be cited the recent great increases in the abundance and production of lake herring, whitefish and walleyes (yellow pickerel, yellow pikeperch) in Green Bay.

The fishery for the walleye in Green Bay is of unique interest, not because of the poundage involved--the walleye normally stands well down the list of species as regards total production--but rather because this fish not only is highly prized on commercial markets but is also a top-ranking sport fish. This common interest of sport and commercial fishermen in the walleye regrettably is not always accompanied by a community of opinion as to how the fishery may best be regulated for the protection of the stocks and the interests of the groups that exploit them. To the end that the walleye fishery of Green Bay may not become the object of futile and bitter controversy, it is desirable that exact information on the status of the fishery be made available.

Reprinted from The Fisherman 18 (3): 5-6. March 1950.

Assistant Chief of the Great Lakes Fishery Investigations, U. S. Fish and Wildlife Service, Dr. Hile is now stationed at Ann Arbor, Michigan.

This brief article accordingly has been prepared to show the nature and extent of recent changes in the walleye fishery in the State of Michigan waters of Green Bay, to compare the present conditions with those of preceding years, and to offer some strictly speculative opinions as to further changes that may be expected within the next few years. Similar data cannot be given for Wisconsin waters, since that state has only recently removed the walleye from the game fish list. Statistical data given here were obtained from monthly reports on commercial fishing, prepared and submitted by licensed operators and turned over to this Service for analysis by the Michigan Department of Conservation. The same data can serve further to illustrate the type of information that these commercial fishing reports make it possible to compile. Commercial fishermen who may have considered the preparation of their monthly reports over the years as merely a nuisance can take comfort from the knowledge that the information they supply is truly valuable. It is greatly to the interest of the fishing industry for operators to submit their reports promptly and make them complete and accurate.

How great has been the upswing in the production and abundance of walleyes and in the intensity of the fishery for the species in the Michigan waters of Green Bay since 1945 is apparent from the accompanying table which compares recent figures in production, abundance and fishing intensity with those of the 15-year base period, 1929-1943.

The commercial production of walleyes, for example, rose from 21,000 pounds or less than half the 1929-1943 "normal"

Production of Walleyes (thousands of pounds) and Production, Abundance and Fishing Intensity Given as Percentages of the 1929-1943 Average for Each Year from 1944 through 1948

Year or Years	Production		Abundance Index	Fishing Intensity Index
	Thousands of Pounds	Index		
1929-1943	51	100	100	100
1944	43	85	152	56
1945	21	41	89	47
1946	72	141	136	105
1947	262	515	220	236
1948	572	1126	282	403

of 51,000 pounds in 1945 to 572,000 pounds or more than 11 times the 15-year average in 1948. Similarly the abundance of legal-sized walleyes (as estimated from the catch per lift of the types of gear accounting for the bulk of the take) increased from 89 per cent of the 1929-1943 mean in 1945 to 282 per cent or nearly three times the modern normal in 1948. Finally, the intensity of the fishery for walleyes (as computed from records of the actual amount of gear fished) jumped from only 47 per cent of average in 1945 to 403 per cent in 1948. The statistics for 1948 (and to a lesser extent for 1947) are far out of line with those of earlier years. Preliminary figures for 1949 indicate still further increase in production to more than a million pounds or in excess of 20 times the 1929-1943 average take. Until the detailed analyses, now in progress, are completed, we shall not know the relative importance of increases of abundance and of fishing intensity to this record catch.

The question now arises as to how this increase in the abundance of walleyes in Green Bay came about. Was there a gradual, year-to-year improvement in the production and survival of young, or did the increase originate in a phenomenally successful hatch in a single year? Age determinations based on the examination of scale samples collected for me by Mr. Stanley J. Lievense, of the Michigan Department of Conservation, suggest the latter explanation. Of 29 walleyes taken in large-mesh gill nets in Little Bay de Noc on March 23, 1949, 28 had been hatched in the spring of 1943 and thus were six years old at the time of capture. Of 80 fish in a trapnet sample from Ogontz Bay, Big Bay de Noc, 74 were 6-year-olds. In the combined sample of 109 fish, 102, or 93.6 per cent, were hatched in 1943 and the remaining 7 (all 5-year-olds) in 1944. Although this relatively small sample taken in the spring of 1949 may not be perfectly representative of the age composition of the commercial catch in 1948 and 1949, it is safe to conclude that the large catches of walleyes in both years were made up mostly of fish hatched in 1943. Fish of the same year class very probably contributed to the increase in 1946 and certainly to that of 1947.

The reason for the phenomenal hatch of walleyes in Green Bay in 1943 must be given as "unknown." Many hold that the recent great abundance was made possible by the mortality that all but wiped out the population of smelt in the late winter of 1942-1943. Certainly the timing is suggestive and the explanation is made even more attractive by the fact that lake herring and whitefish enjoyed similar increases. On the other hand, one might inquire as to why such fish as yellow perch and suckers failed to benefit. We cannot ignore the possibility that the increase in all three species was not associated at all with the decline of the smelt but rather arose from peculiarly favorable weather conditions, and that the habits of such fish as perch and suckers are such that they were not benefited. In support of the latter interpretation,

I may cite the fact that Minnesota scientists report an exceptional 1943 hatch of walleyes in Mille Lacs where smelt could not have been a factor. We shall need to learn much more about the habits of fish before we can explain the sudden increases in Green Bay and those that have taken place or will occur in other areas.

In the spring of 1950 these walleyes that have made fishing so productive for anglers and commercial fishermen alike, begin their eighth year of life. Although they cannot be termed excessively old--I have seen collections from Saginaw Bay in which walleyes of the same age were plentiful--they must be reaching the point where the combined effects of fishing and natural mortality are reducing their numbers severely. Unless great numbers of young fish are growing up to replace this phenomenal 1943 hatch (and we have no reports to that effect), a decline in abundance and yield toward "normal" conditions is certain. A decrease in 1950 must be held highly probable. That the 1949 level of catch could be maintained through 1951 is conceivable, but I hold it unlikely.

There is a grave danger that with the inevitable return of the walleye population of northern Green Bay toward a "normal" condition, many may view the change as a calamitous decline, and as the occasion for placing heavy restrictions on fishing operations. It is in the very nature of both sport and commercial fishermen to adjust more easily to a rise in the abundance of fish than to the ensuing decline and to accept readily as normal an abnormal abundance.

It would be unfortunate indeed if fishing for walleyes were to be handicapped by unnecessary restrictions such as the closure of grounds or even eliminated by placement of the species on the game fish list simply because the public failed to understand the nature of the changes that have been taking place. We should be thankful for the great abundance of walleyes in Green Bay during the past few years, but should realize that it cannot be expected to continue indefinitely.

REVIEW

FORTSCHRITTLICHE KARPFENTEICHWIRTSCHAFT

(PROGRESSIVE MANAGEMENT OF CARP PONDS)

Wilhelm Wunder

E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, 1949. 385 pp., 219 illus. Price, 40 DM ($10).

Fish-culturists and students of aquatic ecology who have only a fair reading knowledge of German should assign this lucid and simply written book on carp culture to their "must" reference-book list. It has been written for the practical culturist, and a conscientious effort has been made to explain scientific information in lay language.

Professor Wunder was director of the Cooperative Pond Culture Experimental Research Center of Silesia, Germany. In addition, he was director of the Experimental Station for Fish Pond Culture at the University of Breslau. At the close of World War II, Poland took over Silesia

and with it the University of Breslau. Professor Wunder was relieved of his position, and he has been expelled to western Germany until his recent appointment as professor of zoology at the University of Erlangen. Since 1946, then, he has spent most of his time in preparing the materials for this book, which reflects careful and thoughtful preparation.

Over the past 20 years Professor Wunder has published, with his students, many significant papers dealing with the applied as well as the technical aspects of carp raising. This book not only reviews the literature but points up the main problems and their treatment according to the most modern view. Also summarized are his published and unpublished works during the past 20 years of research in eastern Germany, Poland, and Czechoslovakia.

Abundant evidence is assembled in this book to prove conclusively that adult carp in European ponds, contrary to the popular view, feed chiefly on zooplankton (75 percent in carp of age groups 3-4); littoral and bottom animals make up the balance. In carp of age group 0-1, the percent of plankton is not nearly so imposing, as littoral forms make up a greater percent of food in this group than in older fish. These data are summarized from analyses of more than 600 stomachs in which all specimens have been identified and converted to original weights. The charts are complete for feeding habits at all seasons. Wunder has several tables giving the live weight of all the important plankton organisms, littoral and bottom forms, making it possible to convert the weight of a partially digested organism in the stomach to its original weight. In addition to an extremely thorough analysis of natural foods, there are examples of the value and utilization of the artificial foods and their role in enhancing growth. Methods are appraised for accentuating growth of the natural foods with such measures as rotation drying of the pond bottoms and cultivation of the pond soil. Attention to dry fallow has proved its worth as a production-enhancing method. Eradication of the "hard" aquatic plants and some "soft" aquatic plants (some species of large aquatic plants are considered advantageous in carp ponds) is recommended. Artificial fertilization is treated at length. A critique of the various types and quantities of fertilizers is given for different soil and water types. Fertilization techniques are directed toward maintenance of high blue-green algae production. More than 100 pages are devoted to a comprehensive discussion of examples of carp diseases; these are abundantly and clearly illustrated.

CASE HISTORIES OF TWO LARGE FERTILIZED SILESIAN PONDS

Table 1

Year	Number of carp stocked (Age group 2, av. wt., 500 g.)	Total initial weight in kg.	Yield per hektar in kg.	Amount of artificial food added in kg.
1926	140	-	130	110
1932	1,050	-	450	60
1937	300	-	250	450

Table 2

Year	Number of carp stocked (Age group 2, av. wt., 500 g.)	Total initial weight in kg.	Yield per hektar in kg.	Amount of artificial food added in kg.
1928	250	220	320	-
1929	210	120	220	-
1930	270	180	300	-
1931	320	130	350	-
1932	280	220	340	-
1933	280	120	370	-
1934	285	110	420	-
1935	340	100	470	-
1936	480	160	700	-
1937	590	170	470	-
1938	390	110	430	-
1939	510	140	680	-
1940	430	150	600	-
1941	620	140	460	-

454 grams - 1 pound
1 kilogram - 2.2 pounds
1 hektar - 2.47 acres

--The EDITORS

A short but interesting section discusses the influence of environment and feeding on body form of carp. In addition, other aspects of growth are stressed in their relation to culturists' problems.

Of prime importance and interest is a section on inheritance. In keeping with the modern trend in biology, this is stressed; exemplified in commendable fashion, it points up the advantages that the modern culturist might attain from more attention to genetical aspects of fish culture.

The subject of the effect of crowding on production is only briefly sketched. Owing to the importance of the effect of the space factor (crowding) on fish growth and its bearing on yield, the ecologist would like to have seen more data like those in the tables included here, data which demonstrate the upper limits of yield and maximum fish size attained with varying intensities of stocking. Unfortunately, no figures were included for average weights; there is only the comment that the average size of the fish at time of harvest was very much smaller when larger numbers of fish were stocked, e.g., years 1937 to 1941. With such abundant data available, it would have been interesting to the student of fish populations to have had sufficient records for statistical treatment.

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MEASURING WELL WATER

H. R. McDonald

Part 1 - The Reclamation Era 36 (3): 52-54, March 1950. 15¢.
Part 2 - The Reclamation Era 36 (4): 76-77, April 1950. 15¢.
Bureau of Reclamation, U. S. D. I., Washington 25, D. C.

In the first part of this article there is described a simple method of determining the water flow from the end of a horizontal pipe. The measurements required are the diameter of the pipe and the horizontal distance from the end of the pipe to a point where the top of the stream of water has fallen a distance of one foot below the top of the pipe. The flow may then be obtained graphically or by means of an equation. Modifications of the method permit measurement of the flow from the ends of pipes which slant upward or downward. Another modification permits the measurement of flows that do not completely fill the pipe.

The second part contains a method of determining the water flow from the top of a vertical pipe. The diameter of the pipe and the maximum height of the column of water above the end of the pipe are required. The flow is obtained graphically.

All the measurements needed may be made with a carpenter's square and a combination square or trisquare with a slide and level bubble assembly which can be set with a thumbscrew.

Space does not permit reproduction of the illustrations, graphs, and tables which facilitate the measurements. For those with a flair for mathematics, however, the equation for the flow from a horizontal pipe is:

$$Q = \frac{3.61\ AX}{\sqrt{Y}}$$

Q = discharge in gallons per minute.
A = area of pipe in square inches.

X = any convenient horizontal distance in inches measured from the end of the top of the pipe to a point above the stream of water.
Y = vertical distance in inches from the same point to the top of the stream of water.

The methods described here are invaluable for many hatchery purposes, and the progressive fish-culturist should secure a copy of these papers for his library.

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State Fish Hatchery
Rome, New York

CLEARING HOUSE

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INDEX

Volume 12, Numbers 1 to 4, inclusive. References to previously published material are indicated: a, abstract; b, reprint; c, review.

ABSTRACTS a51-52
Age Determination in Fishes, Based on Examination of Finray Sections b47-48
alinement charts 163-168
Allison, L. N. a52
anesthetization 195
Application of Electricity to Collection of Fish 39-42

Bacterial Disease Found in the Black Crappie, Poxomis nigro-maculatus 87-88
Bacteriological Findings in Study of Outbreak of Ulcer Disease among Brook Trout Yearlings of Westfield, Wisconsin, Hatchery 63-66
Bailey, L. P. 81-84
Bass Production in a Kentucky Fish Hatchery Pond 33-34
bass:
distribution units 211-213
effects of insecticides 141-146
farm-pond populations 3-11, 147-150
hatchery production 33-34
species in Maryland 35-37
BHC 141-146
bibliography 97-104
Biological Effects of Nigrosine Used for Control of Weeds in Hatchery Ponds 135-140
Biotin and Brown Trout: Tale of a Vitamin 67-71
Bishop, C. G. 163-168
Black Bass in Maryland 35-37
blindness, white a52
blood study 27-28
Bluebacks from the Winthrop Station 12
Bond, L. H. 169-172
Bonham, Kelshaw a51-52
Borovicka, R. L. 45
Boyko, E. G. b47-48
Brockway, D. R. 67-71, 127-129
Bryant, Maurice, Jr. 91-93
bullheads 147-150

Caine, L. S. c108-109
Carbon Black on East Lake, Deschutes Nat'l Forest, Oregon 45
Carlander, K. D. a52
Carlon, T. E. 89-90
carp c225-227
charts:
condition factor 163-168
production 91-93
Chipman, J. R. 214-215
Chipman Meat Cutter 214-215
chlordane 141-146
chlorine 81-84
Clark, Minor 33-34
CLEARING HOUSE 53, 109, 181-182, 228
Cleary, R. E. 81-84
Code, M. R. 85-86
COMMENTS 95
Comparison of Number of Erythrocytes in Blood of Hatchery-Reared and Wild Silver Salmon Fingerlings 27-28
Condition Factor Alinement Charts 163-168
Construction and Use of Small Trap Nets 185-192
crappie 87-88
Crowe, W. R. 185-192
Curtis, Brian c107-108
Cutthroat Trout without Dorsal Fins 85-86

Day, A. M. 57-62
DDT 141-146
Denmead, Talbott 35-37
Diet Experiments on Atlantic Salmon in Maine 169-172
dip net 217-220
disease:
bacterial, in black crappie 87-88
ulcer 63-66
white blindness ..... [a]52
distribution:
helicopter 73-76
truck 197-206, 211-213
Donaldson, L. R. 27-28
dye 135-140

Effectiveness of Modern Fish Management Practices: Planting ..... [b]173-179
egg:
measure ..... [b]105-107
picker 44
electricity:
fish collection 39-42, 131-134
lamprey control 216
electrodes 39-42, 42-43
Electrodes Used in Electrofishing 42-43
electrofishing 39-42, 42-43, 131-134
electronics 216
encyclopedia ..... [c]180-181
English measurement system 207-208
equipment:
collection 39-42, 42-43, 131-134
egg, measure ..... [b]105-107
picker 44
electrodes 39-42, 42-43
lanolin 32
meat cutter 214-215
net, dip 217-220
trap 185-192
raceway gate 89-90
scale measure 209-210
screen 161-162
sterilization 81-84
switch 220
tanks 73-76, 153-159, 197-206, 211-213
erythrocytes 27-28
Evans, William 161-162
Everhart, M. H. 135-140
Expansion Raceway Gate 89-90
Extra-Boned Sea Trout 196

farm ponds:
bibliography 97-104
farm ponds (continued):
Iowa 3-11
Region 3 147-150
Fessler, F. R. 3-11
fin:
adipose ..... [b]221-222
dorsal 85-86
finray sections ..... [b]47-48
Fish--
and Wildlife Service 57-62
Growth Rates Read Directly from Projected Scale 209-210
Management in Multiple-Use Management of the National Forests 113-126
-Planting Tank for 3/4-Ton Pickup Truck 197-206
Populations in Some Iowa Farm Ponds 3-11
Fisherman's Encyclopedia ..... [c]180-181
Fishery Research Program at Cornell University 77-80
Flakas, K. G. 63-66, 87-88
Fortschrittliche Karpfenteichwirtschaft ..... [c]225-227

Gabrielson, I. N. ..... [c]180-181
Garlick, L. R. 73-76
gate, raceway 89-90
Gee, M. A. 113-126
Graphic Record for Hatcheries Rearing Artificially Fed Fish 91-93
Green Bay Walleyes ..... [b]223-225
growth:
scale studies ..... [a]52, 209-210
tests ..... [a]51-52

Haskell, D. C. ..... 131-134, [c]227-228
Hasler, A. D. ..... [c]225-227
Helicopter in Fish-Planting Operations in Olympic Nat'l Park 73-76
herbicides 135-140
Higgins, Elmer ..... [a]51, [c]107-108, [c]180-181
Hile, R. O. ..... [b]223-225

insecticides 141-146

Joeris, Leonard 209-210

Jones, R. O. 13-25

Katz, Max 27-28
Knapp, F. T. 207-208

LaMonte, Francesca ..... [c]180-181
Lanolin to the Rescue 32
lamprey 216
Lawrence, J. M. 141-146
Leitritz, Earl 197-206
Life Story of the Fish: His Morals and Manners ..... [c]107-108

McDonald, H. R. ..... [c]227-228

management:
brood-stock selection 151-152
Fish and Wildlife Service 57-62
National Forests 113-126
Oklahoma 193-195
planting practices ..... [b]173-179
marking returns 29-31
measurement:
condition factor 163-168
eggs ..... [b]105-107
growth rates 209-210
systems 207-208
well water ..... [c]227-228
Measuring Well Water ..... [c]227-228
meat cutter 214-215
Metabolic Products and Their Effects 127-129
Method of--
Measuring Fish Eggs ..... [b]105-107
Transporting Fingerling Shad 153-159
metric system 207-208
Millenbach, Cliff 151-152
Morris, R. W. 39-42
mortality 126
Motor Directional Switch 220
mussels 13-25

Natural Siphon Egg Picker 44
net:
dip 217-220
trap 185-192
nigrosine 135-140
North American Fresh Water Sport Fish ..... [c]108-109
nutrition:
salmon, Atlantic 169-172
trout, brook ..... [a]52
brown 67-71
rainbow ..... [a]51-52

Percentage Returns of Marked Trout in Two West Virginia Streams 29-31
Perforated Aluminum Screens for Circular Pools 161-162
Phenicie, C. K. 163-168
Phillips, A. M., Jr. 67-71
pikeperch ..... [b]223-225
planting practices ..... [b]173-179
PMA 126
pollution ..... [a]51
ponds:
farm:
Iowa 3-11
Region 3 147-150
hatchery:
sterilization 81-84
weed control 135-140
Present Status of Fishery Management in Oklahoma 193-195
Propagation of Fresh-Water Mussels 13-25
pyridylmercuric acetate 126

Quickly Changed Dip Net 217-220

raceway gate 89-90
Radioactive Wastes and Their Significance in Stream Ecology ..... [a]51
Rainbow Brood-Stock Selection and Observations on Its Application to Fishery Management 151-152
Rayner, H. J. 42-43, 95
Recent Developments in Electric Method of Collecting Fish 131-134
reduction ..... [b]49-50
REPRINTS 47-48, 49-50, 105-107, 173-179, 221-225
Research on Sea Lamprey 216
respiration 127-129
REVIEWS 107-109, 180-181, 225-227, 227-228
Richan, F. J. 217-220

Rodgers, E. O. 67-71
Rounsefell, G. A. 169-172

salmon:
Atlantic ..... 169-172, [b]221-222
blueback 12
silver 27-28
scales:
growth data ..... [a]52
measurement 209-210
Schultz, Vincent 97-104
screen 161-162
Seaman, E. A. 29-31
seine 39-42
Selected Bibliography on Farm Ponds and Closely Related Subjects 97-104
selection 95, 151-152
shad 153-159
Sharp, R. W. 147-150
Smith, A. B. 44
Smith, L. L., Jr. ..... [b]173-179
Some--
Considerations in Use of Fish Growth Data Based upon Scale Studies ..... [a]52
Tests with Experimental Groups of Fingerling Rainbow Trout, on Uniformity and Rate of Growth, Diet, and Photographic Size-Recording ..... [a]51-52
Sonic Experiments Fail to Disturb Trout 150
Stephens, R. F. 29-31, 161-162
Sterilization of Trout Hatchery Pond with Chlorine 81-84
Summary of Farm-Pond Inspections, 1949 147-150
sunfish:
Iowa 3-11
mortality 141-146
Region 3 147-150
transportation 211-213
Surber, E. W. 135-140
Survey of Systems Used in Measuring Lengths and Weights of Fishes, and of Systems Proposed as Standard, in Southwest 207-208
Svardson, Gunnar ..... [b]221-222
Swift, L. W. 113-126
switch 220
Sykes, J. E. 153-159

tank:
helicopter 73-76
truck 153-159, 197-206, 211-213
Ten Years of Fishery Activities under Fish and Wildlife Service 57-62
Thompson, Bill 193-195
toxaphene 141-146
Toxicity of Some New Insecticides to Several Species of Pondfish 141-146
trap net 185-192
Trash Fish Utilization in Utah ..... [b]49-50
trout:
brook ..... 29-31, [a]52, 63-66
brown 67-71, 150
cutthroat 39-42, 85-86
planting practices ..... [b]173-179
rainbow ..... 29-31, 45, [a]51-52, 150, 151-152
sea 196

ulcer disease 63-66
Urethane Anesthetization 195

vitamin 67-71
von Bayer, H. ..... [b]105-107

walleyes ..... [b]223-225
Warning to Users of Pyridylmercuric Acetate 126
water, measurement ..... [c]227-228
Webster, D. A. 77-80
weed control 135-140
White, G. K. 169-172
White Blindness in Hatchery Brook Trout ..... [a]52
Wilson, A. J. 211-213
Wunder, Wilhelm ..... [c]225-227

Interior—Duplicating Section, Washington, D. C. 80342

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Applications for THE PROGRESSIVE FISH-CULTURIST, which is distributed free of charge on a regular mailing list, should be directed to the Editor, THE PROGRESSIVE FISH-CULTURIST, Fish and Wildlife Service, Interior Building, Washington 25, D. C.

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